THE JOURNAL
OF THE
ROYAL UNITED SERVICE INSTITUTION.

VOL. XXXIX. NOVEMBER, 1895. No. 213.

[*Authors alone are responsible for the contents of their respective Papers.*]

BLOCKADE IN RELATION TO NAVAL STRATEGY.

By Captain MAHAN, U.S.N.

THE Council of the Royal United Service Institution have done me the honour to ask a paper upon the following thesis :—

"THE NAVAL STRATEGY OF THE PAST HAS BEEN DEPENDENT "UPON POWER TO MAINTAIN CLOSE BLOCKADE OF HOSTILE "PORTS. CAN SUCH BLOCKADE BE MAINTAINED UNDER PRESENT "CONDITIONS OF STEAM, STEEL, AND TORPEDO-BOATS?"

"IF NOT, WHAT MODIFICATIONS ARE DEMANDED BY THE CIR-"CUMSTANCES, LARGELY VARIED, FROM PAST WARS?"

That this is a question involved in great difficulty, if not obscurity, will be readily admitted by all who have given thought to the conditions, or have had experience of them. No reply can be more than tentative until we have the experience of actual war, or until there is made a more exhaustive attempt, than I think has yet been done, to reproduce all the difficulties—not on one side only, but on both—as well as *all* the careful measures to insure success that would be taken by a man under the actual weight of responsibility. Experiments upon war, in time of peace, have little advantage over a game, unless the effects of danger and of doubt, in inducing caution and precaution, can be represented to an extent that they now rarely are.

Under these circumstances my reply must reduce itself largely to an attempt to compare the conditions of the past with those of the present, in order, not so much to decide myself, as to facilitate a conclusion, whether the change, superficially so great, is really one of kind, or of degree only.

It is allowed on all hands, as an historical fact, that such blockades were instituted and maintained with great rigour and efficacy, though always subject to the chance of successful evasions, during long periods of the French Revolutionary Wars. Under former conditions, often both severe and complicated, the thing was done. The question now proposed is: "Can the same, or an equivalent, system be maintained, under the changed conditions of the present day?"

The fact that the question raised depends upon conditions essentially transient in character—conditions which are of the present, not of the past, nor at all certainly of the future; conditions characteristic of the vessels and of the weapons, with which the strife is to be fought, rather than of the unknown regions which may be the theatre of war—constitutes a fair presumption that the problem itself is in its nature more tactical than strategic—in the strict sense of the latter word.

It is evident, also, that we must not too lightly assume the methods of former days, however admirably they may have been adapted to the ends then in view, as mere precedents, to be followed unquestioningly in our modern practice. We can only safely reason upon the experiences of the past when we have penetrated to, and laid firm hold upon, the principle, or principles, which received recognition and interpretation in our predecessors' methods. When the latter have stood the searching criticism of experience and analysis, we can confidently assert that they were a valid application, under the conditions of one age, of principles that are probably true at all times, and which we may hope to detect by patient study. But when we have correctly stated the principles, it by no means necessarily follows that the application of them will be the same, or superficially even much like those of previous generations.

There is another caution which I think may wisely be observed, namely, not to assume too easily that our forefathers hit upon methods absolutely certain of success in practice—not liable at times to failure. There are few, if any, characteristics of the utterances which I from time to time hear, or read, on the subject of actual warfare, which impress me more strongly than the constantly recurring tendency to reject any solution of a problem which does not wholly eliminate the element of doubt, of uncertainty, or risk. Instead of frankly recognising that almost all warlike undertakings present at best but a choice of difficulties—that absolute certainty is unattainable—that the "art" consists not in stocking the cards, but, as Napoleon phrased it, in getting the most of the chances on your side—that some risk, not merely of death but of failure, must be undergone—instead of this, people wish so to arrange their programme as to have a perfectly sure thing of it; and when some critic points out, as can so easily be done, that this may happen, or that may happen, and it is seen undeniably that it may, then the plan stands condemned. "War," said Napoleon again, "cannot be made without running risks, and it is because my admirals have found out that it can, everything attempted by them has failed." Even had we not that high authority, the experience of the blockade system of the past, which forms the basis of the question proposed for treatment, would show that, however sound in principle was the practice of those days, it was by no means infallible; that it ran great risk of failure from circumstances, sometimes anticipated, sometimes unforeseen; and that such risks, constantly incurred, and indeed inseparable from the conditions, did from time to time cause failure and partial disaster. Most of us will recall Nelson's exaggerated expression, "Nothing ever kept the French fleet in Toulon or Brest when they had a

mind to come out"; but this exercised no deterrent effect upon his resolve "never to lose sight of the Toulon fleet." He and the men of those days, whether they analysed their convictions or not, were of a temper which did not yield under partial defeat. They stuck to a plan which in its accuracy seems almost intuitive, so wanting is it of technical expression, or reasoned statement, in their writings; and, as the principle on which it rested was perfectly sound, and the practice based upon the principle substantially the best available to them, they realised the success which in the great majority of cases will reward a right line of action, consistently followed through the ups and downs of good and evil fortune. As the Scriptures have it, "He that endureth to the end shall be saved."

It behoves us, therefore, to consider, first, what was the principle which found expression in the close blockades of the last century and early years of the present; and here I may remark, in passing, that the very word "close" to a certain extent begs the question, and assumes a power which did not actually always exist for the blockading fleet. Nelson's statement, above quoted, by no means stands alone. "Here we are," wrote Collingwood (I quote from memory), when in charge of the Rochefort blockade, "lying to in a heavy gale, ninety miles off shore. I cannot with certainty prevent the enemy slipping out before I return, yet I should be intensely mortified if he succeeded. *The only thing to deter him is the fear that he may fall into our midst.*" These last words are worth remembering, as indicating the doubt that the enemy too must have—that he, too, must run risks—and that, if the fear here suggested were realised, disaster would fall upon his schemes. Many a happy chance has slipped through the fingers of this or that warrior, because he did not know the hazards to which his opponent was willingly, or necessarily, exposing himself; and excessive pre-occupation of the mind with one's own risks or difficulties is often the cause that blinds men to such chances. I believe that failure to achieve great results is more often due to anxiety about one's own dangers than to over-confidence and rashness. There is a time for prudence, but there is also a time for daring. "It is better to be alarmed now, as I am," wrote Torrington, "than next summer when the enemy is out." Over-caution in campaign may possibly prevent immediate disaster; but it is equally apt to cause ultimate ruin by failure to utilise opportunity. Nelson's biting comment reaches many more men than the admiral at whom it was first launched: "He is perfectly satisfied that each month passes without any losses on our side."

The two great historical instances of blockades, so called, upon a really extensive scale, and sustained with steady resolve through considerable periods of time, are the blockades of the French military ports by British fleets, during the Seven Years' War and the Napoleonic era, and the blockade of the coast of the Southern Confederacy by the United States Navy, during the Civil War, 1861-65. The latter, however, was a purely strategic operation, which may be accurately described as a steady and strangling pressure upon the enemy's lines of communication, with the result of producing exhaustion through the failure of necessary

resources. It resembled, even in method, the continental blockades of Napoleon's decrees and of the British Orders in Council; and of their spirit, except that they disregarded existing international law, it was a precise reproduction, in the suppression of trade through an extensive coast line. Owing, however, to the fact that there was practically no hostile navy to be dreaded, no tactical precautions had to be observed by the blockading forces. These were, in consequence, loosely distributed over an immense line, without any thought of mutual support, or of danger from an enemy. Never did the cordon system, so sweepingly, yet justly, condemned by sound military writers, when adopted as a defensive plan against a valid enemy, receive a more complete illustration; yet, under the conditions of the time, it was admirably calculated for the particular emergency. The United States vessels had not to think of possible injury to their own coast, or to their distant interests, by the escape of the enemy's ships, except in the depredation upon sea-borne commerce by scattered cruisers. The escape of the latter, in isolated cases, through the blockading line could not be prevented; while to protect the trade threatened by their evasion would have required the detachment of so many vessels as to impair seriously the attainment of the far more important military object of the blockade—a fact worthy of most serious consideration in connection with the present subject; for it justifies the remark, parenthetically, that the vast increase of force necessary to repress damage by vessels that have escaped, over that required to prevent their escape in numbers sufficient to constitute a serious danger, emphasises forcibly the imperative need of intercepting such escape, if it can be done. It will probably, therefore, be admitted by all, that the blockade of the Southern coast was a purely strategic operation, involving little or no practical difficulty regarding the manner of distributing the several detachments upon their respective, and often petty, scenes of operations.

The case was radically different with the British Navy in the periods 1756-1763 and 1793-1814. Whatever the strategic plan, the consideration of which we will for the moment postpone, the problem which its adoption presented to the British admirals was one essentially tactical, viz., how to dispose their ships before the hostile ports, and how to maintain them there, in such wise as to prevent the unmolested escape of one or more divisions of vessels, which, if once away, might do incalculable harm before traced to the unknown goal for which they were destined. That the usual tactical aim of the French was the exact converse of this is, I believe, generally recognised. Their object was to evade the force stationed before the port, to shun battle, in order to effect a certain injury to the enemy's possessions; or, in rarer cases, to support large combined movements of the land and sea forces in regions more or less remote. Under such conditions, the duty of the watching fleet, as long as it lasted, was excessively onerous. Not only did it entail a state of uncertainty and prolonged anxiety, indecisive of tangible results, but by far the greater strain fell upon the outside fleet, which was in the position of the defendant and underwent most arduous exposure. For all these reasons,

but particularly because it was necessary to end suspense and to bring matters to an issue, the primary hope of the British admirals was not to shut the enemy up in his ports, but to compel him to battle when he came out, or as soon thereafter as practicable. The blockade therefore was to be "close," so far as that word was at all applicable, for this purpose only. It is well known that Nelson, with his clear perception of facts in their mutual relations, emphatically rejected the term "blockade" as applicable to his own operations before Toulon. "On the contrary," said he, "every opportunity has been offered them to put to sea, for it is there we hope to realise the hopes and expectations of our country"; but at the same time he, with equal emphasis, and free use of superlatives, charges his frigate captains, "It is of the utmost importance that the enemy's squadron in Toulon should be most strictly watched, and that I should be made acquainted with their sailing and route with all dispatch."

Accepting this as the real expression of the British aim, which upon the great authority of Nelson we well may, let us now try to weigh the advantages and disadvantages, as compared with the conditions of to-day, under which the British admirals then worked in conducting a plan, the success of which I presume is now generally accepted. For of one thing I think we may be reasonably certain, that the strategic danger, and the strategic aim, of a navy which seeks to close-watch hostile ports, are the same to-day as formerly. Whatever the number of ships needed to watch those in an enemy's port, they are fewer by far than those that will be required to protect the scattered interests imperilled by an enemy's escape. Whatever the difficulty of compelling the enemy to fight near the port, it is less than that of finding him and bringing him to action when he has got far away. Whatever the force within, it is less than it will be when joined to that which may, at or near the same time, escape from another port. Whatever the tactical difficulties involved, the strategic necessities compel a diligent study of how to meet them.

The greatest change in the conditions, I apprehend, is the facility now enjoyed by the inside belligerent of moving at any time, and in any direction; to which, and incident thereto, is to be added the fact that the indications of an intention to move are less open to observation than formerly. Then, with the wind in certain directions, the outside ships could feel perfectly sure that the opponent could not come out; and when a successful sortie had been made, but the escaping division been seen by a look-out frigate, the course steered with reference to the wind prevailing might (or might not) give some clue to the destination. It would be pedantry to cite from the numerous proofs of these statements in the correspondence of the day. The same is not the case now—certainly not in any degree comparable to what then obtained. Unless I mistake, the general opinion of those who have had experience is, that it is impossible to prevent the escape of the inside ships. Not having the experience, I feel very great diffidence in expressing even a partial dissent; but when I observe that the conviction of the difficulty of detecting an escaping enemy does not seem to qualify perceptibly the

assurance that the low-lying torpedo-boat will easily find its prey under similar circumstances, it appears to me possible that we have here again an instance of the tendency to see all the difficulties on our own side and the advantages on the other. Still, it does remain true that, unless you can compel the enemy to come out at once, or at least very soon, the choice of time and conditions remain with him. All that can in compensation be said is, that the outside party has the same facilities for judging what is practicable at any moment, as the inside; and that the dispositions of each day and night must be made to correspond to the conditions of weather and other circumstances. A night favourable to the operations of the torpedo-boat will not justify the same arrangements as one where it can with difficulty discover its object, or fire with precision.

The question, therefore, presents various phases, but is it not after all essentially one of look-out? of watching a line more or less long, which the enemy may break through at any point, or at least at several points? Whatever the length of the line, the situation in so far reproduces the essential characteristics of one very familiar in warfare, when one party stands on guard over a long line. This has in the past been variously met. The cordon system, so well known from the liberality with which it has for some generations been condemned, sprang with all its faults directly from the necessity of guarding in some way a long line. It is true, however, and will no doubt be urged in reply, that there is a most important difference in the fact that, the line being once broken through, the great mobility of a naval force enables it to be off and away for its destination, and possibly to disappear from sight and knowledge, without permitting that gathering of the defendant's masses which may be necessary, before pursuit can be adventured. Here, however, very much will depend upon the length of the line through which evasion may be attempted. In a port with but one entrance this may be greatly contracted, according to the dependence the outside party feels in his own protective measures against surprise, and especially against torpedoes. Such a port would resemble a river, or a mountain chain, with but one practicable passage. In a port with two or more practicable exits the difficulty is increased in proportion to the distance of these apart, and the other hydrographic conditions. Two entrances may do no more than dictate a central position for the outsider's force, or it may compel him to double it. The weather, again, will modify the length of the outside blockading line—the area, that is, of the circle, upon whose circumference the battle-ships will lie or move. The inner line, the sentries, must always be close in.

It is unnecessary to insist that the belligerent who proposes to take position off the enemy's ports must possess decisive superiority. This is universally admitted. The outsider has the more difficult task; he is on the defensive; he undergoes more wear and tear. He also, as has been intimated, ought to incur as little delay as possible in concentrating a pursuing body, at the least equal to the party escaping. The

only adequate provision for these conditions is greater material force. Moreover, the ships with clean bottoms should always be as numerous—at the very least—as the enemy's ships of the same class within. If track of an evading division is not lost, a very consequential factor in pursuit is likely to be the ship first to give out or to slow down. This is a contingency that cannot be dismissed as improbable. It is just such chances as are continually happening—*l'imprévu qui arrive.* Who, with the experience of summer manœuvres, will say that in a division of six battle-ships and attendant cruisers, pressed at high-speed to shake off pursuit and proceed on a mission—or, on the other hand, to pursue such a force—the risk of a hot journal or some breakdown in machinery need not be taken seriously into account?

Let us, as an example, assume such a division to have run out, and that by clever stratagem or otherwise it has got twenty miles' start—a long start in a stern chase—before the outsiders get on the track. Two of the heavy (or fast) cruisers—look-outs—that should ply in couples between the sentries and the main body, have not lost their touch and are following. It is impossible they should be attacked, for their main body is following; therefore they cannot be shaken off. Assuming equality of speed and luck—and equality at the start must be assumed, unless we are to have problems too hopelessly complicated for discussion—the chance is equal in which squadron a laggard will turn up; but, if the chance happen to the pursued, it is much more serious than it would be to the pursuer, for he must abandon the ship or fight—which, again, means abandon his mission. The pursuer, on the other hand, simply leaves his ship behind and continues pursuit. He certainly would not abandon it, for what has happened to him may next happen to the enemy. Even if it be a battle-ship he has lost, and he therefore is by one inferior, he would not be justified in letting go his grip, and with it the chances which the chapter of accidents may next offer.

It may, however, be urged that this escaping by a whole division is not what will be attempted, but that the inside party will send his ships out separately—on the same or on different nights—with orders to assemble at a given rendezvous. But will he? I at least am not so sure; for if on the one hand there is thus multiplied by six the chance of evasion for each ship, there is also multiplied by six the chance that one will fall in with the whole of the outside squadron. A single battle-ship of the present day is too valuable—in immediate money's worth, in importance to the general operations, and in the length of time required to replace her—to be so daringly, not to say recklessly, risked. The mere capture of one such ship would be no small night's work, equalling, as she would, in tonnage and in intrinsic importance to the operation before her, the five ships taken by Rodney on the 12th of April. I am not disposed to undervalue the advantage of the insider, in that he has the initiative—the advantage possessed by one who has the choice of time, whose different parties move on a pre-concerted plan, for a single, simple object (getting away), over one who cannot distinguish just what

is happening, which is the position of the outsider. On the other hand I feel that, in considering the possibility of effectively watching an enemy's port, which is the *rôle* of the outsider, one is likely, from his very point of view, to be over-impressed with its difficulties; and I am inclined to think that, if the problem posed were how best to win through the toils of a much superior and skilfully disposed outside force, imagination would succeed in making a similar vivid picture of the risks of running out—of the things that might happen, and the disastrous consequences that might thereupon ensue. Men will not in war undertake, with a light heart, adventures which in summer manœuvres entail no more grievous burden of care than a boy's game of hide and seek. Valuable as are the lessons of mimic warfare, there cannot in it be adequately reproduced the element arising from the sense of imminent danger.

Moreover, it should be remembered that, if the blockade has continued for some time, the escaping ships, despite the advantages otherwise possessed by them (clean bottoms, full coal, etc.) will have to do with vessels that have had nightly experience of embarrassments, which they themselves will be undergoing for the first time; a condition precisely analogous to that lamented by Villeneuve when he wrote, "They have not been exercised in storms"; or, as Nelson wrote of the same occasion, "These gentlemen are not used to the hurricanes, which we have braved for twenty-one months without losing mast or yard." Is anyone disposed to reck lightly of the moral effect—that most potent spell—or of the trained dexterity, acquired by the mere habit of doing things in the dark, and under difficulties. Evasions, if undertaken at all, will not be on moonlight nights and smooth seas, but under conditions that will, to say the least, favour evasion. The same conditions will also, beyond all doubt in my mind, as far as their special influence extends, favour the familiar outsider rather than the unfamiliar insider.

It is clear that the difficulties of the outsider are multiplied manifold, if once the evading party is wholly lost to sight; hence it follows that the most strenuous efforts must be made not to let him escape without fighting. If I may, without affectation of pedantry, translate this proposition into technical language, it would read that the strategic necessities of the war demand that the area to be occupied by the outsider's fleet (*i.e.*, before the enemy's ports) be circumscribed to the tract consistent with due precaution against attack, and that there be concentrated upon it such a force as would render escape without fighting impossible. The retort doubtless will be that no one denies this, but that the very question before us is how to prevent the escape. Can any force, however numerous, be so disposed as to prevent a sortie being seen? If seen, can the news of the fact, and the necessary information as to direction taken, and the enemy's force, be so transmitted to the main body of the fleet as to give a probability of the latter intercepting the movement? If once seen, can touch of the enemy be kept? Can any change of direction he may make be also distinctly reported? In short, if such a movement is made and

discovered, and touch with it is once gained, can such touch be maintained until daylight, or clear weather, enable eyesight to resume its functions? After that the question becomes one of alternative speed, and possible accidents.

This series of questions, I apprehend, really states the problem under consideration. The question of relative speeds is not involved, it only comes into play if the fleets see each other, and one is trying to force action; it is, moreover, perfectly simple, as well as outside our problem. Neither is the relative fighting force primarily involved—the superiority of the outsider in this must be assumed—otherwise his attempt to play his part at all is hopeless. The question is simply one of touch, gained and maintained; of immediate and accurate information, and consequently of correct direction given to the party wishing battle. For this, numbers are primarily necessary. The scouting force of the fleet—its eyes, its cavalry—must be so multiplied, organised, and drilled that it can at one and the same time keep track of an enemy and go back and forth to its own main body. This being effectively done, the superiority of the latter comes into play.

Now, there is in this nothing original—nothing whatsoever. It is a mere re-echo of Nelson's cry—not only before the Nile, but at other times—"More frigates!" As a contribution to the question I was asked to treat, the answer I suggest amounts to no more than this, that it eliminates, in my opinion, all subsidiary and related subjects, and reduces the problem to the one simple, though great, difficulty in which I conceive it to consist. The maintenance of a close and sustained watch over a hostile port, of which we have two great types in St. Vincent and Cornwallis off Brest, and Nelson, under very different conditions and methods, off Toulon, involves many intricate problems. There are the questions of the aggregate purely fighting force to be kept up, its movements and position and all that pertains to its instant readiness, questions of supply, of reliefs, of repair, of reserve, difficulties consequent upon weather; but all these are separable, in thought at least, from the organisation of what I have called the cavalry of the fleet. The admirals of former days found it hard to exaggerate their sense of its importance, but the greater facility of movement accorded by steam certainly does make evasion easier than of old; consequently the look-out force must be more numerous, more swift, more systematically organised and drilled.

To make more than a general suggestion, to propose more than a general solution, to go on to propose classes of vessels, methods of operation, and so forth, would, it seems to me, transgress the proper sphere of an officer foreign to the service he is addressing, and for various reasons. Let me, however, recur to one remark already made. The answer I offer may be wholly unsatisfactory, may be a mere lame and impotent conclusion. I of course think that, carefully worked out, first, as to the tactical disposition most conducive to the end in view, gaining and keeping touch, and thence deducing the classes and relative numbers of the vessels needed for the various lines of the

blockade, from the outmost to the innermost, a very adequate plan can be evolved. It would have a general resemblance, doubtless, to the sentries, piquets, and supports, that lie between the main body of an army and the enemy; or, to quote a naval historical instance, to the method of the Brest blockade described by St. Vincent in his letters. But, as I have already remarked, unless the idea is futile—barren—its inadequacy demonstrated by experience or logic, it is not a sufficient reply to show that it may, by this chance or that chance, by this mistake or that mistake, incur failure. If a perfectly sure thing is required, I certainly have none to propose or advocate. Supposing a plan based upon the idea I suggest, or upon any other, the fair question to be asked by one weighing it, is not, "Does this make it impossible for the enemy to escape?" but, "Does this impose upon him such risks as to give a considerable chance of either stopping or crippling him, if he attempt it?" And not only is this chance in your favour to be considered as to the immediate locality, but also as to its deterrent effect upon the enemy; and, consequently, the impediments raised by it in the way of any great combination, dependent upon the evasion taking place at a particular moment. As I have repeatedly argued in my book upon the Napoleonic Wars, it was not the certainty of stopping a particular evasion, but the high probability of frustrating a great combination, that made the distinguishing merit of St. Vincent's system.

The ease of movements both in time and direction, conferred by steam, again intervenes here to exaggerate, in my judgment, both the supposed facility of combinations effected from separated ports, and the assumed consequent danger incurred from them. Sight is lost of qualifying conditions. Men's imaginations, kept in constant activity by the scientific advances and inventions of the day, have developed abnormal agility, and mental pictures are drawn in which fleets get about as though by magic. The movements of modern fleets are in fact extremely hampered, and their scope restricted, by the very elements to which they owe much of their power. Their coal, ammunition, water, and supplies are immensely less, measured in duration of time, than the corresponding factors essential to the efficiency of the old ship of war. Nor are they thus fettered only by causes internal to themselves, but external conditions deprive an evasion of much of its former menace. Squadrons and divisions cannot disappear as completely, nor for so long, not even comparatively to modern conditions, as they formerly did. With a network of cables under the sea to neutral ports, where abide the consular agents of each nation, the need of renewing coal will make a fortnight a long time for a fleet to disappear from the world's knowledge. A fortnight, you will say, will allow much damage to be done. Doubtless, but not vital damage, if the enemy be decently prepared. It is not to be presumed that a maritime nation will allow its vital interests, home or colonial, to be so exposed that a fortnight's gain of time will prove fatal to any one of them; while, as for lesser interests, or smaller injuries, one does not go to war expecting never to get a shin barked or a limb broken.

I think that the consideration of the difficulty of effecting such vital damage will have a further deterrent effect upon the insider—the weaker party—and conspire with that exerted by the outsider's thorough arrangements, to gain and keep touch, to make him very wary and cautious as to what he attempts. Also of course, if the latter accepts Napoleon's dictum that "War cannot be made without running risks," or, as Jomini more strongly puts it, "After all, one goes to war expecting to take risks," he will not abandon plans of offence because there is difficulty in them, or because disaster may ensue upon failure. The weaker must be the more wary and the more cunning; but he should not despair, and should aim to be also the quicker and the more energetic. The outsider may be stronger before each port than the insider; but the detachment before each hostile port can scarcely be as large as the whole of the enemy's navy. The cruise of Admiral Bruix in 1799 is the conspicuous illustration of the opportunities which chance may offer; though it must be remarked that that chance was obtained, not by a mass formed by detachments combining at sea, but by one already gathered in a single port, from which it issued in mass. The intended subsequent combination with the Spaniards proved in fact a failure; it could not be effected, until after the possible offensive purpose of the cruise had been defeated, by the junction of the British divisions. "What a game had Admiral Bruix to play," said St. Vincent; and Nelson afterwards: "Your lordship knows what Admiral Bruix might have done, had he done his duty." The opinion of two such men, then on the spot, stamps beyond question the possibilities offered to the inside party, by chances inseparable from war. The attempt to close hostile ports against evasion is almost imperative upon a nation dependent upon the sea; yet if done less than efficiently—I do not say "absolutely"—it may quite possibly involve greater danger than leaving the ports unwatched, and simply keeping your own fleet massed and in hand, which was Lord Howe's plan.

In conclusion, I should be inclined to summarise the whole question somewhat in the following manner, which will doubtless involve a certain amount of repetition. Using the term "blockade" loosely, as the nearest single word to comprise any close watch over the entrance to an enemy's port, with a view to impede egress or ingress, such blockades are of a twofold character—offensive and defensive. The first is directed against both egress and ingress, but more especially against ingress, being meant to prevent the entrance of needed supplies, and being therefore essentially a blow at communications. The second also has a twofold aim, but its chief object is to prevent egress unmolested, because such freedom of issue to an enemy means danger, more or less great, to certain national interests; which, because they lie outside the national boundaries, cannot be protected by ordinary defensive measures, by fortifications and organised land forces. Such a blockade is, therefore, essentially defensive. Resort to it implies the existence of great national *external* interests, which are open to injury, and can in no other way be so cheaply, sufficiently, and certainly defended. If the external exposed interests

are many, it is impossible to imagine any means of guarding them equal in efficiency to that of heading off danger at its sources. This is the strategic necessity—the decisive strategic consideration, which dictates the method essential to be adopted. Resort to this method implies, besides the external interests, a naval strength so superior as to permit being before each port watched, in force superior to that of the enemy within. This is a simple question of preparation, which, however arduous it may be to the national resources, presents no intellectual problem difficult to be solved. It is a question principally of money, secondarily of preparation, not only adequate in the aggregate, but adequate in the discretion with which that aggregate is apportioned among the various branches of the fleet, based upon a due recognition of the part which each branch will have to play in a proposed blockade. Such antecedent appointment is as really tactical in character as is the disposition of a given force before a given port.

Further, to assign to a given blockade a fleet of battle-ships, superior in any required degree to the inside enemy, presents no problem perplexing to the intellect. The real problem is to assure a reasonable probability that that fleet can bring the enemy to action, if he attempt to come out. This is a matter of look-out, instituted and sustained, and of means of inter-communication between vessels of the blockading force —whether by signals or by hail. This is the crux of the matter, and it is one so intricate and onerous, subject in execution to so many mishaps, that I do not wonder it should seem insoluble. Without due personal experience, I speak with utmost diffidence, but I believe that by the employment of extensive means it is possible to attain, not certainty, but that degree of probability which, both in actual result and in its deterrent effect, would largely insure the end in view, the protection, namely, of the external interests of the country. The question involved is the defensive watching of a given front of operations. The system must resemble in general features that of an army similarly engaged. Nearest the enemy the units of force must be small, and their commanders deeply impressed with the sense, not only of the need of quickly gaining and sending information, by whatever means, but also and still more that the safety of their individual commands is as nothing to the performance of the duty assigned. Why, even, should it be thought improbable that a resolute attack upon an issuing force, by the look-out lines, though necessarily inferior, should so embarrass or injure the enemy under the difficulties of night, as to gain time for its own main body to come up— or else might frustrate the movement by the resultant confusion? Certainly it is contemplated, on all hands, that attacks by torpedo-boats from inside will be one of the greatest anxieties of a blockading force; why should it not in a degree concern one trying to run out? In land warfare, inferior force often retards or disquiets movements which it is inadequate to prevent; can no ingenuity figure analogous use of naval force? Many things go to constitute inequality besides physical or material strength—position, opportunity, accident, chance, a happy

inspiration. There is nothing in the essential nature of war which makes improbable, under any change of ships or weapons, that there should be repeated the part played by the frigate "Penelope," in impeding and ultimately frustrating the escape of the 80-gun ship "Guillaume Tell" from Malta, in the year 1800. A party whose one aim, for whatsoever reason, is to evade, is sorely hampered in its endeavours to shake off even a much inferior foe. The fear of the delay entailed may prevent it from resorting to measures which, under other circumstances, would soon crush the petty intruder.

In short, to summarise once more in a sentence, the question—the old question and the new alike—is not, "Can any enemy be prevented from coming out?" but, "If he does, can touch with him be gained and preserved?" Steam, in my opinion, has simply widened the question, not changed its nature. I believe that provision can be made which will give a high probability of success, but I do not believe in certainties in war.

Wednesday, July 3rd, 1895.
General Lord METHUEN, C.B., C.M.G., in the Chair.

ON MOUNTAIN WARFARE: INDIA.

By Major F. C. CARTER.

THE subject of mountain warfare is one that claims, as regards our Army in India, more than usual interest; in fact, modern warfare, as applied to India, might be classified with but very few exceptions as almost exclusively "mountain."

The history of our Indian possessions for the last eighty years is prolific in examples of mountain warfare carried on across the frontier, and furnishes ample material for the student of this branch of a soldier's profession. We have not time this afternoon, however, to discuss the several frontier expeditions in India, dating from the Nipal Wars of 1814 and 1816, where our eyes were first opened to the difficulties of Himalayan warfare; and from thence on through a series of wars all round our frontiers, terminating *pro tem.* with the Chitral Relief Force of 1895.

There is, however, of all these campaigns, one which I think, as we have but lately again crossed swords with the same foemen, deserves more than a passing word, if only to show how we have in 1895 profited from the lessons in mountain warfare learnt in 1863. I allude to the Yusufzai Field Force of that year, commonly known as the Ambeyla expedition.

The account of this expedition abounds with thrilling episodes of hard fighting, desperate losses and daring heroism, and also with examples of the difficulties and uncertainties of mountain warfare as applied to India. In the first place, when the expedition started it was not expected that the Bonairs and Swatis would join in the rising against us, it being well known that they were by no means well disposed towards the Hindustani fanatics, who were the real cause of hostilities. Yet, no sooner had the force arrived at the foot of the Ambeyla Pass, than it became evident that there was a regular hostile gathering of the tribes, both Cis and Trans-Indus. Here then occurred one of the uncertainties that are coincident with our mountain warfare: instead of, as had been decided, attacking the Hindustanis from the North of Mahaban, with our backs to the friendly (?) tribes in Bonair and Swat, it was found that to adhere to this plan of operations in the face of this enormous coalition was impossible; and the whole aspect of the campaign became suddenly changed.

For fifty-four days—from 22nd October to 15th December—did our army, acting against fearful odds, stand at bay on the position chosen at the Ambeyla Pass, during which time there was scarcely any cessation of hostilities. Over and over again were our advanced piquets attacked by the ever-swelling numbers of the coalition. No less than three times was the famous Crag Piquet taken and re-taken, and the Conical Hill, Eagle's Nest, and Water Piquet were all scenes of desperate hand-to-hand fighting, during which many a brave soldier laid down his life, and many a brow earned laurels that time can never efface from the history of our wars in India.

Still, in spite of the enormous losses inflicted on the tribes, and dissensions that sprang up amongst them, victory, lasting and sure, never crowned our efforts, until on the 15th December our forces assumed the offensive, and, moving down into the Chamla Valley, defeated the enemy at Lalu and Ambeyla.

These operations cost us the loss of many officers and men, and taught us the impolicy of penetrating a comparatively unknown mountainous region with a heavily and hastily equipped force. They also clearly portrayed the immense disadvantages of the defensive, and equally immense advantages of the offensive, when dealing with Asiatics. They pointed to the absolute necessity of an efficient Intelligence Branch at Headquarters, and showed the utter folly of having a political officer working independently and without the knowledge of the Commander-in-Chief or General Officer Commanding the Force.

The above may be said to be the chief lessons we learnt on matters to be avoided in future. But at the same time, though doubtless avoidable errors in judgment were not a few, the Ambeyla expedition of 1863 shines out brilliantly among a long list of our frontier wars, as blazoning forth what can be, has been, and will be, done, should necessity again arise, by the indomitable energy and bull-dog pluck of the British soldier and his dusky brother-in-arms; for never have valiant deeds deserved the honour in which they are held, more honestly and rightly, than those enacted in the famous struggles at the "Katlghar."[1]

What I have just read to you, I wrote in 1893. Since then necessity *has* again arisen on the same frontier and against practically the same foe; and I think that we may safely say that while profiting from the past as regards organisation, mobilisation, strategy, and tactics, the army in India has shown that the attributes of valour, which rendered glorious the terrible episodes of the Ambeyla campaign in 1863, are still in 1895 the attributes of the British soldier and his dusky brother-in-arms.

The subject of "Mountain Warfare: India," is one that embraces so many varied questions, that I think it will be as well to discuss them under separate headings.

Preparations.—"Semper paratus" should be the motto of the Government of India with regard to its arrangements for war across the frontier, as

[1] *Anglicè*—"Place of slaughter," by which name the Crag Piquet has since been known among the tribes.

there is no conceivable means of telling, a fact we are constantly having brought to our notice, when the inflammable material that forms the border to our Indian possessions may, through some unforeseen occurrence, suddenly ignite.

We are not like other European nations who war chiefly in civilised countries, where railways, supplies, and houses are available. In our case transport, clothing, shelter, and supplies, all have to be provided at a moment's notice. As regards the first, I will discuss that later on; and provided the schemes in peace-time have been carefully worked out, there should be no hitch with regard to the second and third. The fourth item takes time; it is naturally out of the question to move troops to the base if you have nothing to feed them on when you get them there, and as the supplies obtainable on our frontiers are (with, perhaps, the exceptions in some cases of Indian corn, rice, bhussa, grass, and firewood) few and far between, the majority of stores have to be transported from the nearest mobilisation go-downs to the base of operations. It stands to reason, therefore, that in order to carry out this, and to give necessary orders to camel and cart contractors, purchasing agents, and others, the Commissariat Department should have the most timely warning. Until they are in a position to feed the force to be employed from the base onwards, it is useless sending up driblets of men (except those such as sappers or pioneers required for work) to eat up the food as it pours into the base.

Medical.—However complete may be the organisation equipment and *moral* of our troops engaged in mountain warfare, they all will avail but little if the medical and sanitary arrangements are faulty. In the record of our frontier wars, it is by no means difficult to recall cases where, owing to lack of experience, false economy, or insufficient *personnel* and material in our medical arrangements, the whole object of the expedition has been within measurable distance of general collapse.

A great tendency to be avoided is the "cutting down" of medical staff and the number of field hospitals required for hill campaigns, a tendency that has no doubt arisen partly from motives of economy, and partly from the healthy state the troops have generally been in during our late frontier wars. The danger of such false economy was, however, clearly shown with the Isazai Field Force of 1892, when, owing to fever, sunstroke, and cholera following on an attempt to reduce the hospital establishment, the resources of the Medical Department with the force were severely taxed.

Another medical question of some importance in mountain warfare is the carrying of wounded men. The stretchers now in use are by no means suitable for steep hillsides, as there is nothing to prevent the sick man from sliding off the canvas, either in front, in rear, or on either side. On two occasions, even when carried with the greatest care, I have seen this happen to a wounded man, thus endangering life and causing fearful and unnecessary pain. It strikes me that some sort of arrangement consisting of merely a net or canvas hammock, carried with or without pole,

would be preferable (*vide* Sketch A.). I do not think such an arrangement has ever been tested on service; after all, it is but modernising the old idea of the infantry sash.

As regards the clothing of our troops and followers in mountain warfare, where the thermometer may show either above 100° or below zero, experience dearly bought has shown that it is folly to save a few pounds weight in the matter of transport at the risk of incapacitating our fighting machine or its followers owing to want of proper clothing. Neglect of this precaution was felt during the winter of 1879-80 at Kabul. Still more marked and more disastrous was the state of the transport coolies of the Lushai Field Force of 1871-72, especially during the operations at Tipai Mukh and the advanced posts.

Sanitary.—To detail all matters connected with the sanitation of a force would be out of place here this afternoon; suffice it to say that in mountain warfare, owing to the nature of the hills, the density of the jungle, or the ever-vigilant attitude of our foes, it is necessary for our camps and bivouacs to be confined within far closer limits than when fighting in the plains, and this alone necessitates a far more careful inspection of *minutiæ sanitatis* than is otherwise necessary. Take, for instance, a campaign in Sikkim, Lushai, or on our N.W. frontier. All ideas of laying out camps as shown in regulations are at once discarded. Where, in the plains, we should put one regiment, in hill campaigns we probably have to arrange for three. This alone necessitates special arrangements for conservancy. Then, whereas in the plains, when requisite, camps can be shifted, maybe a mile or so away to fresh ground; in the hills the probabilities are that there is no fresh ground available, and therefore every endeavour must be made to keep the ground well ventilated and dry by opening up the tents by day, or, when necessary, by striking them altogether in order to let the rays of the sun penetrate the soil where the men sleep. It is usually necessary, in our mountain wars, for reasons of safety to have the transport lines within the limits of camp or bivouac; but during the day time, when possible, all animals not actually required for duty should be moved out to standings well away from camp, so as to open out the ventilation during the day, and prevent the soil from getting polluted beyond the power of even King Sol and an army of sweepers to rectify. Bazaars and lines of native followers, cooped up as they are often obliged to be in a very limited space, require a deal of supervision. The necessity of ordinary sanitary precautions does not appeal to a native. There is but one remedy for this: I allude to the powers of the Provost-Marshal.

Transport.—Perhaps *the* most difficult problem to solve, were our forces in India to be engaged in mountain warfare on a large scale, would be that of transport.

The transport that has been employed by us up to date in mountain warfare consists of:—

1. Country carts.
2. Transport carts.

3. Elephants.
4. Horses and ponies.
5. Bullocks and yaks.
6. Camels.
7. Mules and donkeys.
8. Coolies.

All the above, with the exception of yaks, were used during the Afghan War of 1878-80, though after just touching on items one to five, I will confine myself to items six, seven, and eight, which are really, practically speaking, the only satisfactory means of transport (other than railway) for hill warfare.

1 & 2.—Country carts are only suitable in intervening valleys. Transport carts at the base and on roads with slight gradient. The latter can, of course, be taken to pieces for transporation.

3.—Elephants, as we know, have been employed on frequent occasions, in Afghanistan, Lushai, and the Black Mountain. Perhaps the most astonishing work, as regards transport by elephants, was that done when provisioning Fort Lungleh (Lushai) in the spring of 1889, which was materially assisted by elephant transport. To watch these huge beasts literally feeling their way and crawling along in bad parts of the narrow tracts from Phirang to Fort Lungleh was a real eye-opener to those who had not seen elephants employed on bad hill jungle paths before. Elephants are, moreover, in a country like Lushai, easily fed, which is not the case on the N.W. frontier; still, when it is considered that an elephant on fairly level ground carries 15 mds. (1,200 lbs.), *i.e.*, equal to the load of three camels, seven-and-a-half mules, and from twenty to thirty coolies, the carrying capacity of the animal is not to be despised.

4 & 5.—Horses and ponies, bullocks and yaks, would only be employed when mules were not available. Ponies and bullocks are regularly used by traders across our frontier, and travel well over bad country; but they are not so hardy, fast, or strong as mules. Should our wars take us over the hills to the "Roof of the World," yaks will play an important part in the transport—they are strong, sure-footed, and hardy.

6.—It is impossible to imagine warfare in or from India unassociated with the camel, and we may safely say that, whether we war in the plains or in the mountains, the "unt" will certainly form part of the force. I am not aware what steps have finally been decided on by the Government of India in view to their being able to call up on emergency a large reserve of camels, but I fancy the subject has lately come under discussion again, and the mere fact that the Punjab alone furnished some 46,000 camels for the last Afghan War leads to the inference that the breed is not dying out.

There is a trait connected with this ruminant mammal that seems to require further development. It is that the camel adapts himself in a most marked manner to the nature of the country in which he is bred. For instance, those bred in sandy plains suffer extremely from wet, cold,

and rocky ground, but are impervious to heat; while those brought up on hilly ground have the pads of their feet hardened, are accustomed to cold, steep hills, and rocks, but suffer from sunstroke. The majority of camels in India come under the first class, and from a perusal of the history of the last Afghan War it is apparent that many camels died from want of acclimatisation, which might have been prevented to a certain extent, had more care been taken in their selection for the different descriptions of work required.

I am of opinion that the Government of India should give grants of land in the hills to camel breeders to start farms, and turn out a real hill camel suitable for mountain work, more of the stamp of the Bactrian as regards coat and feet. This idea I have been told is Utopian, but I, nevertheless, think that it is possible, or at all events, considering the enormous demand for hill transport, well worth a trial; and I look forward at some future date to seeing the embodiment of this Camelus Utopianus in the flesh, which should be a sort of cross between the Bactrianus, the Dromedarius, with the habits of the Llama.

7.—Mules are the backbone of our transport for hill warfare. Where a man can go it may almost be said a mule will find his way. A casual glance at the orders issued for the last half-dozen frontier expeditions will at once show what a very large proportion of mule transport is required. The primary result of this is that the mobilisation mules of corps detailed in the general scheme (but not for the particular expedition about to start) are taken away from regiments and packed off, maybe to the further extremity of our frontier for use there—a system open to grave objections. The secondary result is that mules have to be found by hook or by crook, hired or bought in the districts, and this means time and probably delay, which, in the case of frontier expeditions—take, for example, the two unexpected cases of Manipur and Samana in 1891—may also mean loss of life and prestige: and holding the position we do in the Orient, it is really an open question as to which is the most serious. The latter frequently follows the former, and the former not infrequently gives birth to the latter. The question, therefore, of an ample reserve of mule transport for mountain warfare is one that appeals very strongly to the Government of India, who have had the matter but lately again under consideration; but the long and short of it is that the difficulty lies in the usual channel, viz., expense. That a reserve of mules could be obtained, there is no doubt. We can purchase them in India, Persia, Italy, Spain, the Cape, and elsewhere; and there would be no very great obstacles to be overcome, were a regular mule breeding establishment started in, say, Kashmir or Kulu. The cost of *maintaining* them in peace time is *the* difficulty, and until the civil authorities see their way to overcoming the adhesiveness of red-tapism and the subjection of contractors' claims to the welfare of the empire by co-operating with the military authorities, and using the reserve of mules during peace-time for district and municipal work, any reform and advance in this direction must perforce remain in abeyance.

8.—In mountain warfare under peculiar circumstances the only means of transporting stores is by employing an army of coolies. It is at best an unsatisfactory arrangement, but where the route taken is merely a track, or where the path has to be cut through impenetrable jungle, the employment of *genus homo* as a beast of burden is inevitable. The great difficulty with coolie transport is the small amount they carry (20 seers in the hills), and the fact that they have to carry food for themselves as well as the troops, in addition to their own blanket, water-proof sheet, cardigan, and cooking pots. Considering all this, the enormous length of a convoy of coolies in mountain warfare is not to be wondered at. For a force of, say, 1,000 fighting men sent on an expedition of only fifteen days, a coolie corps of between 7,000 and 8,000 is necessary. This alone is sufficient to damp the ardour of any commander, keen on rapid movement. In addition to this, there is the further drawback that the men die, desert, or get ill, or for some other reason become ineffective as carriers, though they still continue to eat up the food.

There is one other kind of transport for hill warfare, which, with us, has not been turned to much use beyond our frontier, I allude to the railway; and, without doubt, in our next great mountain war, if we mean to keep pace with the times, and turn to some use our tremendous mechanical resources, we shall have to make large strides in this direction. The question, of course, is, What sort of railway should we employ? and this is a point open to discussion. For rapidity of laying and actual carriage of material, a "portable" railway, say, 2-foot gauge, strikes me as the most suitable. A system of several sections of the lines of communication from base to front might be instituted. In valleys the rail would be used; where possible, plain camels; or over mountain tracks, hill camels, mules, and in special cases coolies. By this means we should avoid using mules over sandy soil, and plain camels over steep, rocky pathways, and yet not interfere with the continuous stream of supplies going up to the front, which would also be materially lessened in bulk, as railway trucks do not require feeding. Take, for example, a section of a country as given in Sketch B., which gives an idea of the division of labour which I wish to convey.

Marches.—That "victory depends on the legs of the army," is an old saying, and open to argument; but that success in mountain warfare is commonly affected by the legs of the army is undoubtedly true. To ensure that we shall not, in the hour of need, fall short in this respect, continuous training is necessary. As a rule, nowadays, an infantry commanding officer's chief idea is to avoid a large percentage of third class shots, and to this end he strives, forgetting that marksmen with third class legs are but poor soldiers.

We are told that the success of military operations depends in a great measure upon the compact and well-regulated order of march; it also depends on the nature of the route, particularly in mountain warfare. In 1863 the Sukhawai Pass, leading to Chamla, was reported to be "easy in the extreme," but turned out to be a mere track, covered with rock,

thorny bushes, and cut up by ravines, thus delaying the advance, which could only be made in single file.

Take, again, as another example of a faulty and but slightly-known route in mountain warfare—Suvarrow's march across the St. Gothard, in 1799. Could anything have been more disastrous? Again, in Sikkim, on 20th March, 1888, during the advance on Fort Lingtu, the difficulties in that small fight chiefly lay in the steep and broken nature of the road; the snow, too, which near Garnei was only 2 or 3 inches, increased in depth as the force proceeded, and the final charge was made over snow from 18 inches to 2 feet deep.

In "Mountain Warfare: India," more often than not, the invading force has to make its road before the troops can advance, and the order of march is generally as follows:—

Advanced guard (infantry with signallers).
Covering party to pioneers or sappers at work on road.
Pioneers and sappers (making road, and moving on as it becomes passable).
Mountain battery or batteries, and escort.
Infantry.
Field hospitals.
Baggage guard.
Rear guard.

Reserve ammunition, pakhals, dandies, entrenching tools, and hospital panniers must accompany each regiment or battery, following immediately in its rear, as in hill warfare it is impossible to tell accurately when a fight may occur; and in a narrow pathway or through thick jungle it is impossible to get ammunition or hospital requisites from the rear of the column without great loss of time. Halts should be regular and frequent in steep country. Where forests or jungles are thick, or where a cliff is precipitous—as, for example, parts of Lushai, Burmah, Hunza, Chitral, and Allai, where roads have to be made *en route*, the rate of progress must necessarily be very slow, often not more than half-a-mile per hour, owing to the immense labour of bamboo cutting, tree-felling, digging and blasting; and where time is the all-important factor, as was the case in General Gatacres gallant push forward over the Lowari Pass towards Chitral, the obstacles which Nature in her savage mood presents to the advance of the troops are, I think, among the most exasperating of mountain warfare difficulties.

With marches over snow we have had a very fair experience in India, and Captain Borrodaile and Colonel Kelly have lately shown what can be done on emergencies. Marches should be so timed as to cross over the snow passes at break of dawn, ere the sun thaws the crust. When moving up a hill-side, covered with snow, there being no pathway or means of knowing how the ground lies, a track should be taken along the ridge of a spur, or along the main watershed to avoid drifts; this was done in the reconnaissance to the Machai Peak early in April 1891.

Besides the dangers of drifts there are those of snow and hailstorms

and consequent darkness, and, if the march was begun late, the risk of being benighted in a whirling storm on the passes; and any one who has experienced a first-class hail or snowstorm in the Himalayas will fully appreciate the difficulties on service.

Night Marches.—Night marches in the mountains, especially in winter, are dangerous and difficult. It is often as much as the advanced guard can do, even with the assistance of guides, to find their way at all through black forests and over rocky and precipitous ground, and the accidents from men and mules falling down khuds are increased a hundredfold, added to which there is always in the hills, acting against wild, fanatical tribes, the danger of a panic, especially with young troops early in a campaign ere they have become properly war seasoned.

There are times, however, when owing to the heat of the day, the extremely strong position of the enemy, for the purpose of surprises or other good reasons, it is essential that a start should be made over night. The proposed route should, if possible, be reconnoitred at least partially beforehand; a guide, native of the country, should march with the advanced guard, who will, if necessary, rope him to two soldiers to avoid desertion or betrayal. Guides who perform this duty satisfactorily should be well rewarded in hard cash on the spot. *Bis dat qui cito dat* is nowhere more appreciated than on the marches of our Indian Empire. Lanterns, matches, torches, and a good supply of rope should be ready at hand; the movement of the force should be made with as little noise as possible, and, when practicable, without transport animals. The mountain batteries, in case of night marches, generally follow the infantry of the first line. Dogs and stallions should on no account accompany the force.

Advanced and Rear Guards.—When advancing over open country in the mountains, the normal dispositions for advanced guards with modifications as to distances answer well enough; but in steep, rugged, and dense country, as, for example, the march from Mzari Kandow to Pokul in Allai (1888), the state of affairs is very different. Here, owing to the steep khuds on either side, and the dense forests, the advanced guard could see but little in front of them, and nothing beyond a few yards (except in open spaces) on either side. Any idea of advancing, according to the book, was out of the question. Take another case, that of the march through the impenetrable forests between Demagri and Lungleh (Lushai), in the spring of 1889. Here the advanced guard literally had to cut their way with Kukris (Goorkha knives), making a track as best they could; then halting and placing double sentries as much in a covering line as possible, whilst the main body continued the arduous labour of cutting and removing the bamboos from the track. Either in this case or when working along the Himalayan forests, to attempt any such thing as flankers *moving along with the force*, is dangerous, unsatisfactory, and often impossible. The men find it as much as they can do to look to their footing, and are useless as watchers for the enemy, who, concealed in dense undergrowth, behind trees or rocks, are able to pick off our soldiers as they struggle along their difficult path. I would suggest *stationary* flankers

to be dropped from the head of the column, according to the nature of the country, rejoining the rear guard as they passed. These men could conceal themselves behind rocks or trees, and keeping a sharp look out and remaining quiet would probably be able to get many shots at single men or parties of the enemy, creeping up to harass the advance. In this way we should treat the foe to his own tactics, and if constantly followed he would be more chary about attacks on columns of route in mountainous and jungle country (see Sketch C.).

Attack.—Since the publication of our latest drill book, forms of attack—at least, I should be nearer the mark if I said recognised forms of attack—are things of the past, therefore any discussion as to standard forms of attack for mountain warfare would be out of the question here. Experience gained on service or at peace manœuvres in the mountains can alone teach us how to properly adapt the principles of Part V. Infantry Drill to peculiar circumstances, which are varied by a multitude of considerations as to natural features, climate, vegetation of theatre of war; whether we are engaged in mountain warfare against Russians armed with magazine rifles and modern guns; Afghans or Chinese with breechloaders; Afridis or Kafirs with jezails and a percentage of stolen Martinis and Sniders; Thibetans or Shendus with their blunderbusses, jingals, poisoned spears and arrows; whether we operate over valleys, marshes, snow-capped hills, rugged crags, jungles, or pine-clad mountains; each has to be considered separately in elaborating plans both strategical and tactical; and, as regards the "attack," whether we endeavour to pierce the centre of the enemy's line of defence, as was done by General Ochterlony at Deothal in 1815; or threaten his flank, or double up his forces by a simultaneous attack on both flanks, as was done by General Tytler at Zawo in 1879; or when none of these are possible, and a direct attack has to be made over a confined front, maybe, and perhaps up a precipitous rock, as was successfully carried out by General Channer in his assault on the Chéla Crag in 1888—all very greatly depends on circumstances of place and moment—still, there are certain precepts with reference to the attack in mountain warfare, which, without going to the length of quoting examples, I think we might well discuss here.

1.—In the first place, when dealing with Asiatics—and I think we might almost class the Russian forces in Asia among these—it is ten to one in our favour from a moral point of view alone, if we can act on the offensive, paralyse the resources of the enemy at the start, and follow up our successes *at once*, until he is harried and harried, and stands feebly at bay at the end of his tether. In mountain warfare, the truth of Napoleon's remark, *Le moral est pour les trois quarts, le reste est peu de chose,* is self-evident. A defensive resistance gives courage to the enemy and those independent forces around him who are wavering in the scale. An active and pushing policy, with "short, sharp, and decisive" as our motto, strikes fear and demoralisation into our foe, and converts the wavering tribes around into hordes of wolves upon his track, instead of allies hoping to participate in his success—Ambeyla surely points to this,

and yet more recently as an inverse argument to that of Ambeyla, the action of our ally, the Khan of Dir, speaks volumes in favour of a pushing policy; and when, if ever, the Cossack appears among the wild tribes of Central Asia *en route* to what he vainly hopes may be the conquest of India; let us consider whether we would have the vast hordes of wolves from Central Asia and Hindostan, howling around our defensive posts, or picking up scraps from the trail of the discomfited Muscovite.

2.—In mountain warfare, although the tactical objectives may be ranges of hills and high peaks, the strategical objectives of the campaign at which we must aim, are the big villages and towns in the valleys; and it is only by making our force felt at these centres, and not by waging guerilla and intermittent war among the hamlets and pine-clad hills, that we can ever bring the enemy properly to terms. Napoleon in his criticisms on the way the Engadine Campaign of 1799, was planned in headquarters bureaux at Paris by men ignorant of the art of mountain war save in theory, very tersely remarked, "Mountains depend on the plains, and have no more influence in commanding the plains than the position they afford guns. . . . Your enemy has large towns, fertile provinces, a capital to protect—make straight for these. The art of war is simple and practical, and requires good sense, not ideology." These words are very applicable a century later to "Mountain Warfare: India."

3.—In attacking a strong position in the hills it is undoubtedly a tactical error to allow one's main body to be split up over various passes in crossing the hills to attack; they become separated by time and distance, and give great opportunities to the enemy. The best way to pass a mountain range defended by the enemy, is to make feints at many points, and pass one's main body over at one place, or in columns near enough to permit of easy and timely co-operation. This was done by Sir Robert Low at the Malakand Pass, on 3rd April last with considerable success; a very large gathering of the enemy remaining at Shahkot under the impression, caused by the movements of the cavalry and first brigade on the second, that that pass would be the objective.

4.—Asiatics are always nervous about having their flanks turned or their line of retreat intercepted. This is a truism which should be thoroughly appreciated and acted on by all commanders.

5.—When advancing to attack up steep hill-sides, or through dense jungle, the move must of necessity be slow to allow supports to keep up, and prevent the men being too fatigued when the assault takes place.

6.—Flanking parties should always, when possible, be posted to guard against flank attacks by the enemy, ensure the safety of the main advance, and by bringing a heavy fire to bear on the enemy attract his attention from the real attack, which probably moving over stiff mountainous country can use their arms but little. For this purpose machine-guns are invaluable. When advancing to attack along a ridge or spur great assistance can be given at long ranges by guns advancing up the neighbouring spurs on either side. The screw guns from Barcha, on 4th of October, 1888, did good service by dropping shells into the

enemy's sungar on Manaka Dana, up which spur the first column advanced.

7.—The distances, when fighting in dense jungle or forests, like Burmah, Lushai, and the west slopes of the Black Mountain, must entirely depend on circumstances; but the several parties should be well within touch. It gives the scouts or firing line confidence, and prevents the chance of a reverse, and the head of the column being driven in by an ambuscade.

8.—The advance screen or fighting line should not retire to fight with the supports or main body. The latter should, no matter how bad the ground, move up to hold that already occupied, if necessary, pushing on to a better position *in front*.

9.—Cover should, of course, be taken advantage of in the attack; but I think during the heat of action most officers will admit that it is more difficult, in a rough country, to get men out of cover than into it. To take advantage of cover is, of course, quite proper, and according to the book; but Asiatics, as a rule, do the same, and if both sides acted purely on the defensive, we should never get on at all. When bullets are flying, men take advantage of cover fast enough. The object, however, must always be to drive the enemy from *his* cover, and this cannot be accomplished by firing from behind rocks, trees, or hastily-improvised shelter-trenches. The use of the latter *when* the position is gained cannot be overrated.

10.—An attack once commenced should never, unless absolutely necessary, be discontinued, no matter how imposing the sungar, stockade, or position may appear at close quarters. Once committed, the attack must be followed up, for the moral effect of the loss of a few men in retirement in our frontier wars is infinitely disastrous, compared with the loss of perhaps four times the number in a successful assault. Some brave man will most assuredly find his way into the stronghold, and where one leads many will follow.

Defence.—In operations on a larger scale than we are usually accustomed to on our frontiers, say, for instance, war in Afghanistan, Kafiristan, or Thibet, against a civilised enemy armed with modern weapons, it might be at times necessary to fight a defensive battle, waiting for the enemy to attack us on a selected line of hills, previously to falling on him after he has been repulsed. The nicest observations are necessary in the selection of such a site, which will also be probably affected by reasons political as well as strategical and tactical. The great difficulty in occupying a position in the hills is, without doubt, the enormous number of men required, and the difficult lateral communications. Therefore, it is (I quote Hamley) more consonant with prudence to hold the principal passes, and have the best communications to the rear.

It is, I think, generally admitted that the main infantry defence, especially with the assistance given by entrenchments, should be thrown well forward, in order to get within effective rifle fire of the enemy's guns as they come into position on the hills, and to prevent the attacking

infantry bringing fire to bear on the guns of the defence. Therefore, it is, I think, better for the infantry to push a bit too much forward rather than too little, and ensure good practice, rather than trust to long-range volleys.

The proper defence of camps and bivouacs in our mountain wars is of the very greatest importance; every halting place, though even for a night, should be put in a state of defence, as it is impossible to tell when one may be attacked. Neglect of this precaution (owing to the assurances of the political staff) was met with considerable loss of life and unnecessary hard fighting at Wano last autumn; while the defence of Chitral by Captain Townsend gives us a brilliant example of what can be done, in spite of enormous difficulties, in the defence of posts on our frontiers.

The ordinary methods of putting positions in defence, adopted in "Mountain Warfare: India," consist of earthworks, stockades, blockhouses, and sungars. At Lungleh Post in Lushai, 1889 (Sketch D.), the stockade was 11 feet high with **V**-shaped ditch, 13 feet wide, and 8 feet deep, in front of which the ground was well "panjied" (*i.e.*, studded with bamboo spikes). It consisted of vertical logs let into the ground 3 feet, and tied back with telegraph wire whenever there was any weight of earth behind it; behind the vertical logs were horizontal layers of small timber. At various points raised platforms for sentries were placed. Plan E. gives a rough idea of the sort of stockaded post we had for a detachment of 100 rank and file native troops.

Stockades, bamboo bayonet pattern (Sketch F.), are largely used in Burmah and Lushai. They form a very severe obstacle.

Sungars (Sketch G.) are the normal defences of hill tribes on the North-West frontier. They make very good cover, and with the addition of ditches and obstacles are suitable for bivouacs and piquets.

Villages are capable of being turned into excellent posts of defence, the tops of houses giving a good position for machine-guns. I would, however, consider twice about taking up my permanent abode in a North-West frontier village, unless there was a good supply of Keating with the force!

Sketch H. gives a rough idea of defences thrown up at night round the bivouac on Chittabut in 1888, which were improved on the next day.

Outposts.—Where possible in *small* hill wars, it is, I think, preferable to do away with outlying piquets altogether, and to have simply the limits of the camp well fortified and the field around cleared for fire, thus doing away with any danger of firing into piquets in their posts, or on them as they retire if driven in.

The favourite tactics of all hill men are night firing into camp; it causes great annoyance to the troops and is beset with but little danger to themselves. Every means of counteracting this nuisance should be taken. A few Goorkhas or Pathans, let loose from camp on the "Shikar," often make a very respectable bag of these night visitors, and it has an excellent

effect. It is, however, a mistake to return the fire from camp, and if the tribesmen find after a bit that they inflict no loss, and that no notice is taken in camp of their shooting parties, the game in time, as the charm of novelty ceases, dies a natural death. It has become, therefore, a golden rule on our frontier, that sentries should not open fire at night except in some real emergency, as constant firing round the camp only unnecessarily disturbs the force, and the result, viz., a few corpses strewn round the camp, is of no value whatever compared to a quiet night.

Sentries in our mountain wars must trust as much to sense of hearing as to eyesight, and should be most careful not to unnecessarily alarm the camp. This is not so easy as it sounds; and to those who have done piquet duty in the mountains on dark nights when an attack has been expected, in a country where from rushing water of river or stream, wind rustling in the trees, rocks or stones rolling down khuds, dislodged maybe by strange cattle or wild animals, strange sounds from stranger birds, beasts and insects, and manifold other little incidents, the difficulties and responsibilities of the position are fully appreciable. From intently listening, and listening, maybe intensified by a few shots and perhaps shadowy outlines moving through the darkness, a man's nerves get unstrung, and it is by no means easy to dissever the real from the imaginary.

A bonfire of pine logs or dry bamboo, some distance in front of the piquet is useful on dark nights. Patrolling is often impossible and oftener undesirable. When a piquet is posted on high ground with steep, precipitous but climbable ground in front, which cannot be observed, a collection of boulders ready to roll down on the enemy if they try to creep up under cover of the cliff, is a most satisfactory way of demolishing him with his own petard.

Shelters: Bivouacs.—Shelter for troops from heat, cold, rain, or snow is most necessary. It is a question that affects medical and transport departments inversely; but I think it will be generally admitted that it is wiser—unless, of course, time is the all-important factor—rather than run the risk of a heavy list of sick, to put up with a longer string of transport animals, and consequently somewhat slower advance.

In the majority of our small hill wars, the troops as a rule proceed to the base on F. S. E. Scale 1891, and thence onwards on the reduced scale, known as HFF 1888 Scale, when waterproof sheets take the place of tents. When extreme cold or heat is to be expected for any length of time, tents must be taken; this was recognised in the Miranzai Field Force of 1890 (cold) and the Izazai Field Force of 1892 (heat).

Sketch J. gives an idea of a waterproof sheet bivouac improved later on into a standing shelter.

In Lushai the question of shelter was, of course, more than usually important, owing to the damp nature of the country and the heavy rains, but there the hill coolies worked wonders; ten men would run up a bamboo "basha" for twenty sepoys in three to four hours, the basha being a hut, sloping roof, front 6 feet, back 4 feet 9 inches, closed on three sides.

Roadmaking. — Roadmaking plays an important part in all our mountain wars, as in the great majority of cases we have to cut roads and pathways ere the troops can advance; and for this reason sappers or pioneers should be the first troops to arrive at the base.

As in the first place the tracks required have to be pushed on as the advance proceeds, it is usually best to take the easiest line, though it may be a bit longer, and re-align and improve the road at leisure afterwards.

In countries like Burmah and Lushai, when cutting through dense jungle, kookries or dhaos for all followers are very necessary. The great difficulty here lies in the removal of the long bamboos when cut, as they are held up in their places by neighbouring trees, bamboos and creepers, and, if not removed at once, fall later on and obstruct the road. The sides of the road, too, in damp climates should be cleared of jungle to 4 feet or 6 feet to prevent dew falling on the pathway; this was not done in the first instance on the Demagri-Lungleh road in 1889, and in consequence the track became so slippery that neither man nor beast was able to move on it without difficulty.

Signalling.— Signalling in mountain warfare may be said to take the place of the cavalry screen in the plains. It is to our signallers we trust for information from the front and rear, which may be but five or six miles as the crow flies, but which would take an orderly mounted or on foot many many weary hours of toil, trouble and danger were it necessary for the message to be brought by hand across roaring torrents, up steep cliffs, and over rocky promontories; whereas by means of signalling the message speeds "as the crow flies," o'er hill and dale, in the twinkling of an eye, for you must remember that, with our Eastern sun, the helio is our principal standby.

Our system of military signalling in the field is now classified as :—

1. Electric telegraph,
2. Visual signalling,
3. Mounted and foot orderlies,
4. The telephone,

and is undoubtedly of enormous importance in mountain wars, as a means of communication to and from India, England and the front. Lives have been saved, and many a raid and expedition terminated successfully, due in no small measure to signalling.

Often and often, however, in our frontier wars one has wished that the telegraph instruments connecting the headquarters of the force with the Government of India and Home were at the bottom of the sea; still, these wishes ought not to be able to take root in a well-regulated Government, and the evil communications one has known to pass along the wires ought not to entirely corrupt the manners of warlike general officers and subalterns towards army signalling in the field, the advantages of which are enormous.

Signalling in mountain warfare is quite a large enough topic for a lecture to itself, and we have not time to do the subject justice now; but

to anyone interested in the matter, as regards India, I would recommend a perusal of a paper on the subject in the *Journal of the United Service Institution of India*, for August, 1892, by Captain Hamilton, I.A.S., Bengal.

Rifle and Gunfire in Mountains.—A great deal has been written on the subject of elevation required for different distances when firing up or down hill, and all sorts of calculations are made to arrive at the exact difference of sighting required. The idea, however, of going into these details on actual service is, of course, out of the question, even presuming the actual range was accurately known, which is most often impossible. It is quite sufficient to know that whether firing up or down a hill, less elevation is required than when firing on the level, and that again less elevation is required when firing down than when firing up hill.

Mountain battery screw guns are *facile princeps* the artillery for purely mountain warfare on steep ground. They are mobile, and can practically go where infantry can; they carry 144 rounds per gun (of which thirty-three are case), have a range of 3,200 yards with "time," and 4,000 (or really as far as can be seen to lay correctly) with percussion fuse. They can come into action, each gun, in about a minute, and can "limber up" again (load on to mules) in about forty-six seconds.

Boats and Rafts.—Boats and rafts have played important parts in our border wars in Afghanistan, Hazara, Burmah, and Lushai, and are often absolute necessities. On the Kurnafuli (Lushai) as far up as Rangamutti, the steam launch "Chaffinch" was of the greatest assistance; beyond that, owing to the rapids, the only boats available were the ordinary "dug-outs" of the country; they answered fairly well, though, especially at the crossing places at Peski-Surra and Burkul, a larger stamp of boat would have been useful. I have never seen collapsible boats employed on service in India, though they are often used for shikar purposes; and I am inclined to think that a perusal of Mr. Berthon's lecture in this Institution in March last, and the discussion that followed it, would be profitable reading at Simla.

From what I have seen of fighting on the Indus and Kabul rivers, my idea of a useful boat would be a species of flat-bottomed, stern-wheel steam-launch, drawing about one foot of water, and capable of holding about thirty riflemen, and a machine-gun or two, with bullet-proof sides and roof, and an arrangement of loop-holed shutters (*vide* sketch K.).

Rafts of timber, bamboo casks, and mashks (*i.e.*, goat skins), are all useful. Mashk rafts have been used to a considerable extent in Afghanistan and the N.W. frontier. They are easily made up, portable, easily repaired. I remember bringing some sick and wounded down from Jelalabad to Dhakka in 1880 on a maskh raft, and although several of the mashks got cut above Elachipur, the raft was quickly repaired, and without much difficulty, though under a dropping fire from the opposite hills at the time. The arrangement of a "charpoy" (native bedstead) on

four mashks is a first-class means of conveyance for shooting parties in peace or war.

Bridges.—Some sort of bridges, boat, suspension, trestle, or pier are required in all our mountain wars, whether to cross rivers, streams or chasms. They generally have to be constructed of material at hand, which with the assistance of rope and telegraph wire usually meets all wants. In cases where considerable width of swift-flowing river crosses the lines of advance, a strong boat, pontoon, or raft bridge is necessary, and on the Indus and Kabul this can be arranged for; and there is still a supply of Attock boatmen who are adepts at this work, though since the old Attock Bridge was done away with the race is gradually dying out. Sketch L. shows a bridge of boats thrown across the Indus at Kotkai in the Black Mountain expedition of 1891 in two days. Another description of bridge used in this campaign with great success was the flying bridge at Bakrai. Sketch M. gives you an idea of the travelling block used, and the way the boats work.

For crossing nullahs, pine trees thrown across with ends firmly fixed, and roadway of cross timbers and grass answer well enough, as do double and single lever bridges of trees or bamboo. Suspension bridges made chiefly with telegraph wire were used at Gilgit, and lately for crossing the Panjkora (*vide* sketch N.); and rope bridges after the Kashmir pattern are useful at a pinch.

In Lushai, Burmah and places where bamboo is plentiful, very good bridges for mule traffic can be made; they look fragile, but stand work well. A number were made in Lushai in 1889, varying in length from 15 to 40 yards. All the necessary material was found on the spot, the roadway being made of bamboos opened out after the fashion of a wooden kettle holder, the uprights, baulks, railings, etc., of whole bamboo, the lashings of split cane.

Intelligence and Political.—In working in the field across our frontiers timely intelligence of the movements and intentions of the tribes is most essential. The burden of this work devolves on the Political Staff, and the Intelligence Branch of the force must work hand in glove with them, if any proper work is to be done. Spies, of course, innumerable, will be found from among the tribes hostile and other; but as in nine cases out of ten their reasons for coming into camp are to find out what news they can, and make money by serving two masters, their reports have to be taken very much *cum grano;* though sometimes if the political officer is well in touch with the head men across the frontier, a certain amount of useful information may be obtained. The *quantity* is never wanting, the difficulty lies in sifting the wheat from the chaff. The best information is generally that obtained by native soldiers of our Army, who have, on many occasions, given proof of their loyalty to their salt on these delicate missions.

Conclusion.—I have now, as far as time will allow, touched on some important points connected with my subject. It stands to reason, however, in a subject such as this where the several conditions under which

mountain warfare has been and can be waged are so varied and complex, that time, place, and circumstances can alone decide what the particular tactics or strategy should be.

It is, however, possible to divide mountain wars in India into two great heads, viz. :—(1) Campaigns undertaken to defend our position and uphold our prestige in India ; (2) Punitive Expeditions.

In the former, we must of necessity put forth our whole available strength, as the issues are life or death to our rule in India. Every minutia of our power must be strained to its utmost, for to a moral certainty we have in this class of war to contend against fearful odds. Our every available gun and rifle must be brought into play, and our infantry carefully reserved for the final onslaught of the decisive battle by scientific use of our guns to prepare the way for attack from positions well chosen, which will give us the advantage of ground in some way equalising the advantage of the foe as to numbers. An active policy as advocated in note 1 on the Attack is above all things necessary, for political problems are intricately interwoven with those strategical, and on them the active or passive measures adopted have a marked effect.

Under the latter head, viz., "Punitive Expeditions," the plans adopted must in a way vary from those of the former. The active policy is as necessary as ever, but the means adopted to pursue it are different. We are not fighting on these occasions against an enemy well armed and superior in numbers (*i.e.*, to our *available* forces), but as a rule against ill-armed and undisciplined tribes, and the object is to inflict punishment on them—not to defend our own position, though maybe to uphold our prestige.

When the tribes decline to carry out their agreements with the Government of India, stir up strife, or commit murders on our frontiers, they must be dealt with summarily like children, "Whilst any hasty exertion of physical pressure to the exclusion of other methods of adjustment is confessedly impolitic" (I quote from Mr. Davis, Secretary to the Punjab Government, 1864), "there is a point beyond which the practice of forbearance may not be carried. As without physical force in reserve there can be no governing power, so under extreme and repeated provocation its non-employment is not distinguishable from weakness."

The orders of Government having once been given, the tribes should be made to understand that it is a case of "obey, and operations will cease," or, "disobey, and punishment swift and sure will follow." When on the 2nd November, 1880, in hope of gaining time and negotiating after true Oriental fashion, the Marri Chiefs came to see Sir Charles MacGregor, he absolutely refused to discuss the matter. After recapitulating to them the terms, and explaining what he should do in case they were not agreed to, he concluded as follows :—"Yes or no, in one hour ; you must either fight or obey the orders of Government. For myself I do not care much which you do, my troops will be very glad if you fight. Now go away and settle matters." This speech had the desired effect,

and is a very fine example of the way, and the only way, to deal with Orientals.

There is one other point regarding punitive expeditions which, I think, calls for note. It is this: In order to achieve the purposes of a punitive expedition, it stands to reason that the tribes must be *punished*, and to do this effectually we must inflict on them losses in men, material and money: the latter two it is possible to do, without actually meeting him in the field; but the moral and lasting effect of the first is intrinsically of far greater importance than the latter two, and to ensure this we must get to close quarters with him. Now, armed as we are with long-range guns and rifles, experience has shown that mountain tribes are year by year less inclined to meet us in the open; the mere firing of shells and long-range volleys at the opening of a campaign keeps them at a distance, and instils in their minds a very natural fear of combining in any numbers in the open to offer resistance to our advance; the result is that the main difficulty nowadays in punitive expeditions is *to get at the enemy to punish him*, his tactics being to move off as we advance, contenting himself with desultory and harassing fire into camp at night, and leading us with all our paraphernalia of war on a wild-goose chase over rugged hills and through thick jungle.

I have known those high in authority declare that guns should be brought into use as early as possible in a mountain expedition, in order to paralyse the tribes at the outset. Now on this point, as regards punitive expeditions, I venture to disagree, as I think by commencing operations in this manner we at once destroy our chances of ever inflicting any serious loss on the enemy. Rather would I recommend in this species of warfare that, at the outset, the enemy should not be unnecessarily alarmed by long-range volleys and bursting shells when he is a mile or so away; but that he should be, as it were, encouraged by our seeming inability to strike him afar, until worked up to a pitch of excitement and belief in his own capabilities he is at length drawn on to fight in large numbers at effective range. Then is the time to strike a blow, and, though it may seem bloodthirsty, the mowing down of a few hundreds at one fell swoop is a far more politic and humane method of dealing with him, than killing off small numbers here and there at long ranges, and working havoc to his homes and harvests. Therefore, I would say, in punitive expeditions, keep your guns and long-range volleys until you have met the enemy in masses within easy effective range; and then, when he has been mown down and repulsed, carry on your successes to the bitter end by following him up *at once*, and using guns and rifles to their fullest extent. The probable result will be that, having been thoroughly hammered, the tribes will be but too eager to come to terms, which, in nine cases out of ten, they will not do if physical force is made subordinate to verbal and written overtures, the golden rule with Asiatics being to hammer them first, and then dictate terms; and by this method only will a speedy, satisfactory, and lasting settlement of the frontier be obtained.

Finally, I would add, before the day of issue arrives, when across our border lands we have to meet, maybe, the hordes of Russia and Central Asia marching under the shadow of the Imperial Eagle, let us do all within our means to consolidate our power and prestige within the limits of Hindostan and along its vast line of frontier land; let us train our men to overcome the multitudinous difficulties and hardships of mountain warfare; let us keep the machinery of our military engine in thorough working order, that when the day of decisive battle arrives, we may advance, with our full strength, thoroughly trained and equipped, our rear resting on the loyalty and cohesion of the native states, the frontier firmly rivetted by strong lessons of the past, and the future with no dark cloud of uncertainty looming in the distance, but the road clear and straight to victory, honour, and the consolidation of our Empire in the East!

Dr. MAGUIRE: My lord, ladies, and gentlemen,—I do not think as a general rule it is desirable that people like myself should take part in these discussions at all. I think that they are more intended for setting forth the experience of practical soldiers than for airing the notions of mere book-worms and theorists like myself. But this occasion is a very peculiar one. I do not see how any patriotic Englishman, who has studied history at all, could sit silent after listening to a lecture such as that which has been delivered—a lecture which I do not propose to criticise; I only propose audibly to express the admiration which I have been silently feeling for the last hour. There is something very remarkable indeed in the fact that the people of these islands should by an extraordinary destiny find themselves fighting on the frontier of India; in fact, traversing the Himalayas, the Hindu Kush, and the Suliman ranges. This is a thing so very remarkable, and of such intrinsic and romantic interest, that really a person like myself is scarcely able to deal with it coolly, as one is liable to be carried away by his enthusiasm. We are not all Highlanders, although from recent comments in military papers one would suppose the British Army was entirely composed of officers and men drawn from one particular and mountainous part of the United Kingdom, most of us are dwellers in the plains—for example, the plains of East Anglia—some of us even from the very low-lying bogs of Ireland. That we should be called upon to go by sea to the mouth of the Ganges, and after going up the valley of the Ganges then to ascend the very pinnacles of the North-Western mountain range, and carry on the campaigns which have been described in minute detail by the able and experienced lecturer clearly, is almost miraculous. These certainly are matters which should be constantly set before the British public. The officers and men engaged in these campaigns are worthy of the highest possible esteem and praise, and for my part I derive a great deal more gratification from following them than in studying the details of Vestry questions which pass for politics among so many of our statesmen. To go into some of the details of this most excellent essay: the speaker begins by referring to the present Chitral field force. The time will come, I suppose, when the operations of that field force will be fully commemorated by some brilliant historian; in my humble opinion, they are fully as worthy of being commemorated as the proceedings of Alexander the Great in precisely the same district. Alexander the Great won eternal fame by starting from Macedonia, traversing Asia Minor and Persia, and then going from Biluchistan, over the Hindu Kush, and then back again by the Swat and Buner Valleys across the Indus. If Greek historians, like Arrian and Plutarch, thought the Macedonians' operations worthy of immortality, why should not our people be equally enthusiastic about the march of our soldiers from the Punjab and Cashmere North-Westward, even as he came from the West, Eastward? I am sure the learned lecturer is

perfectly familiar with these facts, but as it is such a very common thing for British men to depreciate British deeds, I always like to get a chance of proving that our exploits are at least as worthy of being recorded as those of any other nation. Alexander, in 327 B.C., did not do more wonderful things than Kelly and Low have done in the year 1895; thus our own annals are fully as deserving of study as those of Greece or Rome. The gallant lecturer referred to other European nations engaging in mountain warfare where railways and supplies and horses were available. In the historic mountain warfares, railways were not available, and Napoleon, for example, had no railway to carry him either up to or over the great St. Bernard, and MacDonald had no railway, Suvarrow had no railway, Diebitsch when he crossed the Balkans had no railway; indeed, Gourko crossing the Balkans had no railway south of the Danube. I take it the lecturer refers rather to railways up to the foot of the mountains—at least, in this particular paragraph—than to railways through the mountains; but even then I suppose circumstances will occur when the mountain warfare will have to be provided for without referring to railways, though I quite admit that the introduction of railways has produced a most remarkable effect on modern strategy all round. On the next page the lecturer refers to the camel making himself perfectly at home in any district. I have not had much experience with the camel; but my reading, and the remarks of some experts whom I know, lead me to believe that it is a most unsatisfactory beast in many respects and far from adaptable. Again, the lecturer says a mule will find its way anywhere. Mules are sometimes very troublesome things to deal with. There is a very remarkable example of that in Jackson's campaign in the Shenandoah Valley, when the mules absolutely refused to conduce to the comfort of the transport in any particular. It was ultimately discovered that the mules were trained in Texas, and that as General Jackson had forbidden swearing in the Army, it was quite impossible for the muleteers to induce the creatures to do their duty till he removed the order, and they were cursed into mobility. To refer to another point in the lecturer's essay. On page 3 he says: "Take again, as another example of a faulty and but slightly-known route in mountain warfare—Suvarrow's march across the St. Gothard in 1799." I do not know how the lecturer interprets his word "faulty," because I do not think the fault was in Suvarrow at all; I think the fault was with the Austrian allies of Suvarrow. I used to think that only for their mistakes the march of Suvarrow was an exceedingly bold and effective march indeed. Suvarrow came into Italy over the Julian Alps, and then advanced, conquering the valley of the Po to Milan. He then moved over this celebrated pass, but was checked by another great mountain warrior, the daring Lecourbe, at Airola and Altdorf, but he escaped very skilfully by moving to his right and getting by Ilanz into South Germany. I should like an explanation of the word "faulty," if the lecturer could spare time at the end. The lecturer refers to the different ways in which mountain passes can be turned or carried; I might refer to one very extraordinary example of the manner in which a mountain pass can be carried by a *coup de main*: that was Napoleon's case at the end of 1808. When he came to Somosierra he found it very strongly occupied by the Spanish, and he carried it by a charge of cavalry. I do not know whether that process would be repeated in mountain warfare in Chitral or Afghanistan, or any other locality to which the lecturer referred, though I believe the cavalry acted very efficiently recently. The lecturer, on page 4, says the Asiatics are always nervous about having their flanks turned or their line of retreat intercepted. I do not know that this nervousness is confined to Asiatics; I think it would be found that all soldiers get very nervous indeed when there is any operation threatening their line of retreat or threatening to turn their flank. I know volunteers are particularly careful to avoid having their flanks turned, and a celebrated Federal maxim in the American Civil War was: "Our people are all right as long as they can stand and look to their front, but the moment their flank is attacked they immediately

proceed to retire, like the breaking up of a camp meeting." Of course, the less disciplined the race the more fatal will be a flank attack—in that I entirely agree with the lecturer. Again, in speaking of the defence of Chitral by Captain Townsend, I am afraid I would only trouble you with another outburst of patriotic enthusiasm, therefore we will take it that the gallant Captain deserves all the praise that any soldier or civilian can bestow upon him. Our lecturer speaks of our prestige in India, and he speaks of that immediately after speaking about Napoleon and the influence of the *moral* in war. Clearly every Empire is more or less dependent on prestige, and I thoroughly agree with all the remarks of the speaker in that regard Our Empire in the East, more than any other, depends on prestige. I would have said a great deal more about mountain warfare once I started, had it not been that my time is up, and I can assure the lecturer I have listened with the greatest possible pleasure to his address. We ought to be ready, as he says, for fighting, and when we are not absolutely fighting we ought to think of how we can best fight when need arises; and in his excellent address the lecturer has given us abundant material for thought. I hope when it is published it will be very widely studied indeed.

General J. J. H. GORDON, C.B.: My lord and gentlemen,—In the interesting lecture to which we have just listened, Major Carter has ably set forth many valuable lessons learned in mountain warfare in India. I have often felt that some condensed record of the experiences gained there under such varying conditions would be extremely useful reading for officers, our army being so constantly engaged in such operations. During the last forty-five years we can show a long record of expeditions, great and small, against the brave and hardy mountaineers in Northern India—men, soldiers by nature, in whose eyes courage is the highest of virtues, cowardice the basest of crimes. The conquest of these highlanders involves effort of no mean order. They are showing themselves quick to move on with the times, and are advancing in the art of war. They are getting civilised in their special trade of killing their enemies by importing the best rifles and keeping stores of ammunition. They can skilfully and rapidly throw up formidable breastworks, and, as was shown recently at Chitral, can mine, devise means for the reduction of forts, shoot straight at the loop holes, and select the best points for operating upon. They showed themselves recklessly brave at the late action of the Malakand Pass, when in accordance with their time-honoured custom of opposing any invader, they stoutly fought our powerful force, facing magazine rifles and Maxims, every man pressing to the front, whether he could contribute a rifle, a knife, or merely a strong hand to hurl stones at the enemy. There is great scope for individual talent and resource in such warfare. The commander must free himself from many considerations which regulate the conduct of war in civilised countries, as a change must take place when one side only plays the game of scientific war. For this reason, study of our numerous wars against irregular and guerilla foes will show the great importance of an officer learning to think for himself, of cultivating an eye for country, power of natural observation, and the exercise of thoughtful common sense. Reference is made to the necessity for our army in India being ever ready for war across the frontier, and for continuous training to this end. The recent rapid mobilisation of a strong force for operations towards Chitral, and the advance of our troops to the relief of the beleaguered post in face of appalling physical obstacles, show that these conditions are maintained, and that it is the spirit which animated the army which enabled it to triumph over all difficulties. At the same time uninterrupted work in perfecting our organisation both for offence and defence must always be our policy. Night marches are referred to as difficult and dangerous, but they have been frequently made with much success, on occasions when a sudden blow had to be struck. Surprise is the greatest of all foes. I have been present on several occasions in mountain operations when, by means of night marches, we have surprised the enemy at dawn with complete success,

and gained strong positions at far less loss to ourselves than would have been incurred in daylight attacks. The most notable occasion was the attack on the Peiwar Kotal in December, 1878, during the Afghan War. The enemy had carefully prepared a naturally strong position on the crest of high pine-clad mountains, extremely difficult of approach. By a circuitous night march over the roughest of routes, the main column of attack was placed on the flank of the position at break of day, completely surprising and routing the Afghans. It was a bold conception, skilfully and fearlessly executed. There are times when specific advantages outweigh conventional and general objections. A brave leader with a cool head may be left to judge for himself if, in order to gain a victory, the opportunity has come to commit what might be considered a tactical error in allowing one's main body to be split up in crossing the hills to attack. In such warfare the great point is to study and understand your enemy and his mode of fighting; to open the campaign with a severe lesson, and, having inspired fear, to provide him such ample occupation in taking care of himself as will allow him no time for offensive enterprises; to force him on the defensive and keep him there by vigorous movements. The military capacity for night attacks, similar somewhat in tactics to our own, is markedly shown by the Waziri tribe on the North-west frontiers of India, and they have executed them on us on two occasions with a certain amount of success. A night attack upon the British camp at Wano in Waziristan last year was cleverly planned and boldly executed. The Waziris by a night march crossed the hills, attacking at the darkest hour before dawn, posting a party on one flank to cover the attack by rifle fire, another in front to divert, while a rush was made sword in hand on the other flank, the tribesmen penetrating to the centre of the camp, and inflicting much damage before they were beaten off. I merely mention this to show that we meet on that frontier enemies who are not to be despised, who possess military qualities and are apt observers, ready to take advantage of any weak points, and how important it is to study the mode of fighting and characteristics of the various tribes with whom we are likely to come in conflict. I differ with the lecturer as to the desirability of doing away with outlying piquets altogether in *small* wars, and defending the camp on its own ground, simply fortifying its limits, to avoid piquets being fired into in their posts. This would not improve matters. Instead of a piquet being harassed, a few of the enemy might harass the whole camp if allowed to approach it with impunity by night, and they might gain important points from which at daylight an annoying fire could be opened on the camp when engaged in preparing for the march. The greatest attention should even be paid to outlying piquet duty and to patrolling. To do otherwise would induce relaxation of vigilance. I am glad to have an opportunity of endorsing his opinion, that the advancing force in certain localities should be protected by means of stationary flankers instead of moving ones. Such operations can best be carried out by principles of practice and experience according to the facts to be dealt with on the ground, not by those of theory. To establish the local superiority is the first principle to act upon, whether in attacking the enemy's position or in defending the camp or the line of advance. I think, however, that the stationary flankers he refers to should be dropped from the advanced guard, instead of from the head of the column, the advanced guard being strengthened for the purpose. This I have seen done when passing through a long formidable defile densely wooded throughout, below and above, so as to render crowning the height useless—parties of fours being stationed at intervals in the wood at short distance on each flank, and supports left at any open spaces, to remain in their positions till the rear guard reached them. Troops operating in the mountainous regions on the Indian frontier have to carry their supplies with them. This necessitates long lines of transport animals extending for miles along narrow rough paths, the force sometimes becoming a working party to improve the route for the passage of the transport. The line of advance

is generally along narrow valleys, broken by smaller ones at right angles. Flanking parties moving along with the force in such a country are at a disadvantage and check the advance of the column. My experience has been that starting with a very strong advanced guard, stationary flank piquets left by it in commanding positions can effectually watch the line of advance, these piquets being withdrawn as the rear guard arrives, and moving on rapidly to join the column, or strengthening the rear guard if necessary, that generally being the object of attack by the enemy as night approaches. The force is thus passed along in a covered way secure from being harassed by small parties of the enemy, and the advance is thereby quickened. This is the first paper on Mountain Warfare that I have heard read in this Institution. As the British Army is so liable to be engaged in such warfare, I hope Major Carter may give us another paper dealing in detail with some selected operations.

Surgeon-General R. Harvey: As Major Carter was good enough to ask me to do so, I will say a few words as to the purely medical part of hill warfare. Everybody who has had any experience of it knows that, unless troops are kept healthy and fit, and well, great danger arises to the expedition. We have had this proved repeatedly. I remember in my first experience in Bhutan when the medical arrangements were on the old footing, under the system of regimental hospitals, they practically broke down, and the amount of suffering, disease, and death was enormous. The 11th Bengal Infantry were very nearly wiped out of existence, and a wing of the 31st Native Infantry lost something like sixty men from disease in a month, and the losses from disease were out of all proportion to those caused by the enemy. Similarly, in the Lushai expedition of 1871-2, where the regimental system was still in force, although supplemented by a certain arrangement of base hospitals, in consequence of a desire for economy, and partly also from ignorance as to the conditions which had to be encountered, the men were overworked, underfed, and subjected to terrible climatic conditions; the expedition was to my own knowledge on several occasions very near catastrophe. A new system, as most of you will remember, was introduced suddenly just in the beginning of the Afghan War. This was an illustration of swapping horses in the middle of a stream, and great inconvenience was the result at first. The Medical Department afterwards got itself more into sympathy with its new conditions, and did exceedingly good service in the latter part of the war, as was testified to by Sir Donald Stewart. The lessons we learned from this were, fortunately, brought to good results, and of late years an enormous improvement has taken place in the arrangements of the Medical Department on field service. This was shown very clearly in the two Miranzai expeditions in 1890-1, to which Major Carter referred. In the first we had no fighting, but we had to fight in the most desperate way with the elements: we had severe storms, converting the camp into mud, we had frightful cold, and often as many as 20° of frost, the men were very hard-worked and were subjected to hardships of every description; they were, however, exceedingly well fed, exceedingly well clothed, exceedingly well sheltered, and had any amount of firewood. The consequence was that sickness and mortality rates were about half what they would have been had the troops been doing nothing in cantonments. The second expedition, which took place in the hot weather, gave very similar results, although it was organised very hurriedly. The troops at first were exposed a good deal, and there was more sickness than during the first, but at the same time the rates still remained very much below what they would have been in cantonments, and for the first time, I believe, in the history of a British expedition, our losses at the hand of the enemy were very considerably more than those from disease. This shows that the Medical Department has advanced with the times, and is prepared, if given a fairly free hand, to take such care of the troops committed to them as to enable them to do their work in a successful way. I may say, however, that the consequence of the new arrangements by which

regimental hospitals were abolished is that the field hospitals, being the means by which the sick and wounded are now treated, it is absolutely essential that field hospitals should be supplied. The present medical arrangements with corps units suffice only for the immediate treatment of sick and wounded prior to their being sent to field hospitals. Unfortunately, however, the other day, from a desire—a very laudable desire—for economy, and a belief that the campaign in the Izazai country would last only a few days, an attempt was made to save money by sending the force without field hospitals at all. The result, I can only say, was disastrous. I had the honour to be P.M.O. on that occasion also, and had to attempt to do the work with ten medical officers when I ought to have had twenty-six. Having no field hospital, we all felt that the Medical Department was not to blame for the breakdown, which we are bound to admit did occur. The medical officers did all, and more than all, that could be possibly expected; there was one officer who had not his clothes off for seven days, day or night, and they were all worked absolutely beyond the possibility of efficiency. Fortunately, field hospitals were sent up at last; we had them for five days out of fourteen, and they came up in time to save a catastrophe. It is obvious, therefore, that all these attempts at economy are in the direction of false economy, and I hope they will never be repeated. We paid for it severely, we had no fighting, but we had an epidemic of cholera which was quite as bad as if we had had a fight, and it was impossible from scanty material, and from want of medical officers, to make any proper arrangements to isolate the cholera cases, which ought always to be done. The present field hospitals are, I think, although great improvements upon what has previously been in force, still capable of improvement. I think they are too cumbrous, and altogether too elaborate, especially for mountain warfare. The difficulty, of course, in the way of making them very simple, is that they are required to be ready to act in the case of a big war against a great Power; they are not required for mountain purposes only. On several occasions I have organised what I call a flying hospital, by leaving behind a very considerable portion of the *matériel*. Every section of a field hospital being fitted out with supplies sufficient to last for three months, it is absurd in an expedition which is only to last for a week or ten days that three months' supplies should be dragged along. The stretchers is another very practical point to which Major Carter has alluded, and I may say that the regulation stretcher weighs 32 lbs., and that it is absolutely impossible for a fighting man carrying his rifle and ammunition, to carry one of those stretchers up such steep hills as are found in the Black Mountain and similar ranges. I have seen an arrangement very similar to that sketched by Major Carter used in the Izazai country. There the dhoolies could not ascend the hills, and we were reduced to all sorts of straits to carry the men down. We had previously had straps attached to the stretchers with a view of obviating the disadvantage, which Major Carter alluded to, of men tumbling off, which was a very real danger. A man strapped in could not fall out, but he might be dropped bodily, dhoolie and all; and I believe one or two men were dropped. The Ghoorkas, who did most of the transport for their comrades of the King's Royal Rifles, put the stretcher poles on their heads, and it was a sight to see the way the sick (for there were no wounded) were brought down that hill. I invented myself a much more portable stretcher, weighing only 12 lbs., but it has one disadvantage, which was immediately pointed out by Lord Roberts when I showed it to him. He said, "It does not make a bed." It does not make a bed, and the official stretcher makes a very efficient bed, and a very good mess table; but at the same time, the purpose of a stretcher is to carry a wounded man and not to make a bed; and if you can get one which is efficient for the purpose for which it is specially wanted, weighing only 12 lbs., it is a great improvement on one of 30 lbs., which simply cannot be carried. I have known an officer commanding dump down the stretchers and say he would not carry them unless a mule was provided. Mules are not provided by the

regulations, and I had considerable difficulty to induce him to take them on. I think I have said enough to show that the Medical Department, as proved by the Miranzai expedition, can give a good account of itself if it is only allowed a fairly free hand, and is given that which it is entitled to by the regulations.

Lieutenant DUDLEY SEAGRIM, R.A.: Being a Mountain Battery Officer and having spent the last five years of my service on the North-West frontier of India, I have listened to the lecture by Major Carter with great interest. Please permit me to say a few words on the all-important subject of transport with regard to mountain warfare. When an expedition against some tribe on the North-West frontier of India is decided upon, the great problem to solve is how to get the troops equipped with transport, so that they may not only reach the objective point but be always able to detach small flying columns to pursue the enemy in whatever direction he may fly. Lord Roberts has told us that "having got the enemy on the run, then keep him on the run." Now, on the North-West frontier of India, roads across the border do not exist, and in order to be able to follow up a beaten enemy and to catch him, the only transport animal which is capable of moving with the troops is the mule. I have had the honour of being in charge of every kind of transport, from the elephant and the bullock cart down to the coolie; and I believe the general consensus of opinion of experienced officers points to only two animals as being really efficient for purposes of transport on the North-West frontier, viz., the camel and the mule. The camel cannot penetrate into the hill fastnesses of the tribes we have to deal with, and is only good so long as either sufficiently good paths exist or as long as a rapid advance is not necessary. On a campaign once having reached a certain point, we find flying columns are sent out with only mule transport, for we know not whither the enemy may lead us; and this alone will testify to the superiority of the mule over the camel whenever rapid movement in an unknown country is contemplated. There are two kinds of camels, as Major Carter told us, which are used in India, viz., the hill camel and the plains camel. It cannot be too strongly urged that to use the plains camel in the hills is a great mistake, for he is quite unaccustomed to the roughness of the ground, and thus soon gets footsore. He also will not eat for some time the fodder on which the hill camel thrives. Then the question comes, Where are we to get the requisite number of camels of the right kind? That does not concern us here, and so may be passed over. As regards the mule, I fear our sources of supply are all too limited. It also stands to reason that if transport animals have to be bought in very large numbers in a short space of time, a certain percentage will be of an inferior stamp. In the late Mahsud-Waziristan expedition the force was well equipped with mules, and thus at one time from Makin six flying columns were enabled to scour the country in different directions for ten days or more. The result was that the enemy were in many cases surprised by the rapid advance of our troops, and were followed up into places where they had hitherto considered themselves absolutely safe. Rapidity of movement, combined with small columns so as to give the enemy no resting place, is, I feel sure, one of the best methods of teaching a border tribe, who will not stand to fight, the power of the British Army. Rapidity of movement is not gained with the camel, but it is with the mule, who really for a few weeks can well exist on such fodder as can be procured locally, provided this is supplemented with a good grain and water ration. Of course, all parts of our frontier are not alike, and in some places coolie carriage is the best, while in others, such as Burmah, the elephant is by no means to be despised. In short, the conclusion one comes to is that it is best to use carts and animals such as the camel, donkey, or bullock, so long as there are roads, viz., on the lines of communications, where rapidity of movement is not the essential consideration; but once the latter comes into play, then have every available mule up in the front. This applies especially to mountain warfare on

the North-West frontier. In India great strides have of late years been made in the matter of transport, and now that we have the experiences of the Waziristan and Chitral campaigns to show us our weak points, we may hope to reach perfection as near as possible on the next campaign we may undertake. As regards mountain warfare causing great hardships on the men, many of those present here to-day will be able far better than myself to tell you that a campaign on any of our frontiers in India taxes the soldier very severely; and when we read of the details of the deeds which have been accomplished under most trying circumstances, we may well be proud of the army in India. We have in the immediate past glorious examples of what can be done when duty calls. I refer, of course, to Colonel Kelly's march and the advance to the relief of Chitral. Probably no troops in the world are so inured to mountain warfare as those in India—a country which is essentially *the* training ground on which to learn practically the duty of a soldier. The lecture we have listened to to-day is full of interest for every officer, more especially for those who have had the good fortune of the lecturer of being engaged in hostile operations on the Indian frontier.

Captain VINCENT APLIN: As a very junior officer, who started his career in the Crimea, I have had some little experience with regard to the all-important transport; and I do not know that there is anything more important, even at the present day. I am sorry to say, as far as I can gather, we have not made any improvement whatever. One advocates the mule, another the camel, and another the pony. I believe they are all good individually in their own particular countries, but if they are taken out of that country they are comparatively useless. I remember in the China campaign we sent to Manilla for ponies; they had been principally fed on sugar-cane, and consequently when they got to Hong-kong in a short time hundreds died, and in the transport to Pekin we lost thousands. Every pony and every bullock that was sent from India died, and the consequence was we had to fall back on the coolie transport of the country, and we had to loot the villages of all their carts and ponies, and also to bring up a large force of coolie transport from Shanghai and Hong-kong. In that way we succeeded in supplying the army with provisions, otherwise we should have been simply without any at all, except what we found in the country. I have no hesitation in saying that the best transport in the world at present is the Chinese coolie transport. If you have a mule you must have a man to look after it, and that man must be fed and the mule must be fed. We do not take that into consideration. With regard to the carrying capacity of a Chinaman, two good Chinamen will carry 120 lbs. to 140 lbs., and they will carry it at the rate of four miles an hour with the greatest ease, and they are capable of protecting themselves, which is an advantage, and you have only to feed the men; but you otherwise have to feed all your ponies and all the men who look after them, which is a very serious consideration. I am not so well acquainted with the camel, but it strikes me that, as a rule, except in their own particular country, they are very useless. I know that we had a large number of Indian coolies in China, and they were perfectly useless; they could not carry anything, and they would not carry anything. I should be very glad to see—and I am looking forward to the day when we shall find some really good transport—some improvement in a cart of some kind which, drawn by one or two men, would carry a good burden over these mountain passes with facility. I do not see why there should be any difficulty in the present day, with the improvements in electricity, why we should not adopt electricity, or even steam, which they are already doing in America to a very considerable extent, to propel small carts on two or three wheels, which occupy a very small space. I should say that will be the coming improvement. Of course, there would be difficulty in supplying electricity, but with steam we might do it very easily indeed. I think, from very long experience, that all transport must be adapted to its own country, and to

take that transport out of a country is always more or less useless, and the most expensive for any campaign.

Major CARTER, in reply, said: I will only detain you a few minutes, as I am afraid my lecture was rather long as it was. Dr. Maguire was, however, good enough to make some remarks to which in three cases, I think, he expects answers. The first was about railways. I fear I did not make myself quite clear to him with regard to working the line of communications in sections. He apparently understood that my theory was that the railway for mountain warfare was only to be used *up to* the base of the mountains. On the contrary, I wish to use the railway *in* the mountains, which has not been done hitherto by us in mountain warfare. I was not quite sure that this was possible, so when I first broached the subject when I was on the staff at Rawal-Pindi I consulted my friend Mr. James R. Bell, Engineer-in-Chief Frontier Railways to the Government of India, and he quite agreed with me that if we intended to do anything at all as regards improvement of Lines of Communication in our next large mountain war, we must make a greater use of railways than we have hitherto done. He afterwards lectured in the United Service Institution of India on the subject. Where we differed on this subject was that I wished to have 2-foot gauge railways in the hills, and he went so far as to transport the metre or even standard gauge railways of India into the hills. Now, Mr. Bell is a man who does not talk nonsense, a man who has the confidence of the Government of India, and one who would carry through what he proposed. The idea put forward by me this afternoon with reference to "Communications" was, as shown in sketch B., viz., up to the beginning of the hills I have the extension of the existing railway system; then over a light gradient I use my camels that are bred in the plains, here [referring to diagram] we have a fairly level bit, and I use my 2-foot gauge railway; in the next bit, which is a bit steeper, I use my hill-bred camels, who are more accustomed than those of the plains to this sort of country. Then comes another section where I can make use of my railway, then another bit steeper still where I use mules, and in another bit where it is very steep and jungly I use mules, and, if absolutely necessary, coolies. By that means I have a continuous line of communication all divided up into sections, and you avoid what has been always an old difficulty with us in frontier warfare in India, viz., using plains camels over rocky hills, and mules over sandy soil, etc. The second point alluded to by Dr. Maguire was the camel. He doubted the possibility of my Camelus Utopianus. Well, a great many people have doubted that. I am myself, however, a believer in the Darwinian theory of evolution, and I believe the researches of Professors Darwin, Wallace, and others rather point to the possibility of evolving such a camel; not by natural, but by artificial selection. If a fan-tail and a pouter pigeon can be produced from the ordinary bluerock—as you see by an examination of the first case as you go into the South Kensington Natural History Museum is possible—why should we not by artificial selection produce a hill-camel? I believe it is possible. To make quite sure, before I came to this lecture, that I was not romancing about this Camelus Utopianus, I wrote and asked Sir William Flower if he would tell me what he thought about the idea. I have his letter here, and I will read it:—"That camels might by careful training and breeding be modified so far as to be better fitted for mountain work is not unlikely. The llamas of America, which do not differ very much from camels, are mainly used for carrying burdens over the steep mountain passes of the Andes; but how long this modification would take with the ordinary one-hump camel of the plains can only be decided by experience." As regards the other part of my idea on which any doubt has ever been thrown, viz., whether the bactrian and the dromedary would really inter-breed, I have a second letter from Prof. Flower, in which he writes:—"There is a good proof of the inter-breeding of the bactrian and the one-hump camel at the present moment at the Zoological Gardens in the form of a very fine young cross-bred animal." I

think all this rather inclines one to the belief that the "Utopian camel" may some day or other come into existence. Now for Dr. Macguire's third point. As regards my remarking that Suvarrow's march was faulty, he disagrees with me; I still, however, maintain it was a faulty selection of a route, inasmuch as Suvarrow started on this march knowing perfectly well that the route had never before been used by troops. The results to his troops were, as we know, disastrous. I cannot enter into historical argument on the Swiss campaign now as it would take too long, but if I may refer Dr. Maguire to a little-known publication, that is, my Essay of 1893, pp. 435-6, he will see what I mean.[1] General Gordon was kind enough to say a few words, and as regards continuous training for marching, he remarked that there *was* continuous training in India. I quite agree with him; there is continuous training in India, but the British Army in India is a fluctuating factor. As British corps are continually changing, I did not allude to continuous training in India only, but to continuous training in our Army throughout the Empire. As regards night marches, he said I gave no examples. I admit the soft impeachment; I did not. Time was of great importance this afternoon, and although I gave many examples in my original essay on this subject, I left them all out in my lecture. I am extremely glad I did so, because, had I not, General Gordon would not have given us his most interesting personal experiences of night marches in mountain warfare in India. So I can flatter myself that I left them out to some purpose. Surgeon-Major-General Harvey was kind enough to say a few words about the medical aspect of affairs, and as he holds the important position of P.M.O. in the Punjab, and has been P.M.O. of several of our frontier expeditions, and was in the Lushai expedition in 1871, I am sure we all listened to his remarks with the greatest interest, as coming from one who is one of our best authorities on these questions. Lieutenant Dudley Seagrim's remarks were, I feel sure, interesting to all, especially with regard to transport. Captain Aplin, I am sorry to say, seemed to think we had not advanced during the last few years, or even since the Crimea, in the matter of transport. I wish I could transport Captain Aplin to Rawal-Pindi, for I think when there he would change his mind. I have only been in India fifteen years or so, but the strides we have taken in transport in those years are something astonishing. I think any officer who is in this room who has served at all in India, regimentally or on the staff, will agree with what I say, that our transport in India now is far and away better than it ever was twenty years ago, and that is not going back very far.[2] As regards

---

[1] "Take again a case in point from the campaign of 1799 in Switzerland. There, instead of moving against the French by the Simplon, or St. Bernard route, Suvarrow chose that by St. Gothard, as it was the shortest, although he knew it had never been traversed by troops before; with the result that on the 27th and 28th September, so great were the natural obstacles to the advance, it was a question whether he would not have to retrace his steps and try to force the entry by some other pass. He, however, arrived at Schwyz on the 28th with the head of the column, but 'the remainder, scattered here and there among the rocks, struggled till nightfall on the 29th against obstacles that Nature in her savage mood presented to the advance of the troops. The beasts of burden and Cossack horses wore out their shoes on the sharp points of granite and were unable to follow. A great number fell down precipices. Le Courbe appeared on the scene and made confusion doubly confounded.'*"—1st Prize Essay U.S.I. of India, 1893: "Mt. Warfare as Applied to India," by Captain F. C. CARTER.

* "Swiss Narrative of Campaign of 1799," translated by Major-General SHADWELL.

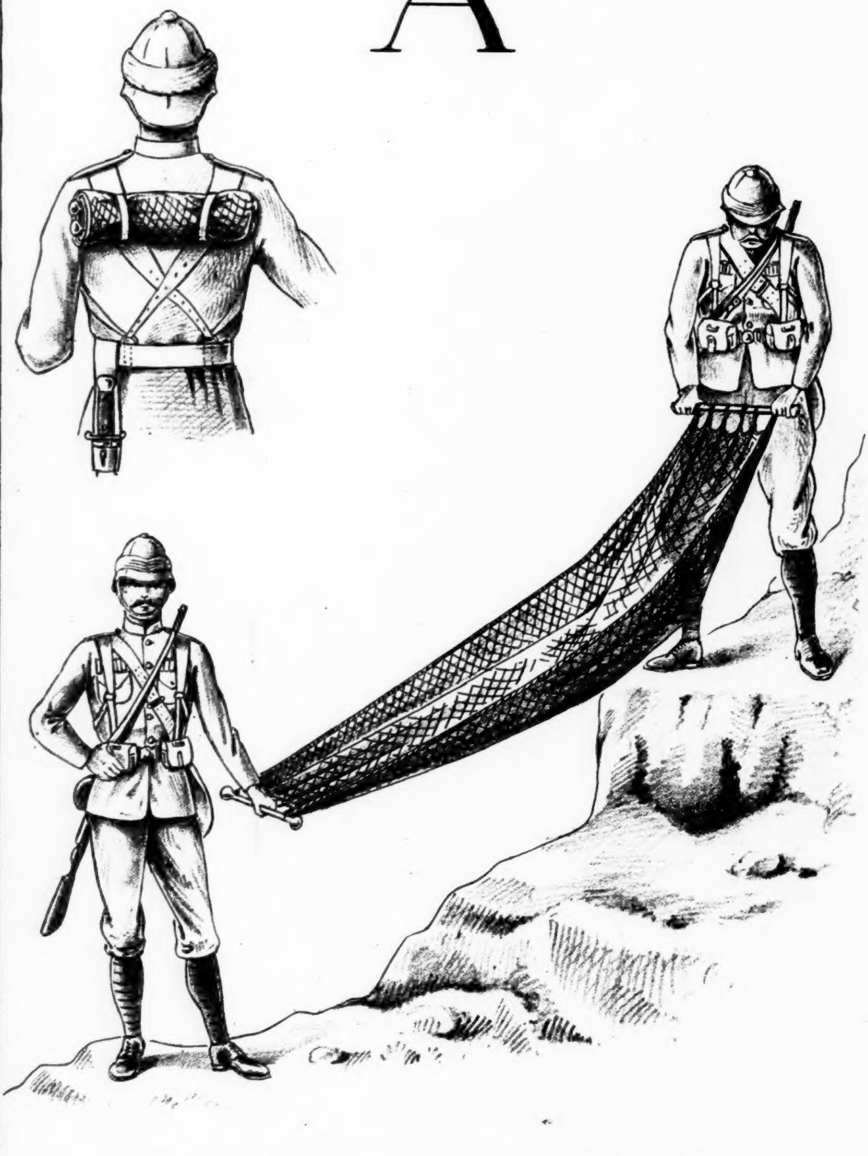
[2] I might have added that the organisation, mobilisation, despatch, and rapidity in movement of the Chitral Relief Force of '95 is about as good a proof of my statement as could be wanted.—F. C. C.

mules, camels, carts, etc., he seems to think that we do not know which is best. I hope I did not give him that idea. We think they are all very good in their own special way. For instance, we do not think camels are good on the top of the Machai peak, nor do we think mules are good across a sandy desert. They are all very right in their proper places, but if I was commanding a frontier expedition to-morrow, and was asked what species of transport I wished to avoid, I should say coolies. I have been on four frontier expeditions in India, and I can safely say from experience I hope I may never have to trust to coolie transport when time and mobility are of importance, and in this I think I am borne out by a good many men who have had far more experience than I am ever likely to have. I have just made a note, as far as my memory leads me, of a few men who have stated that although in such places as Lushai, etc., coolie transport is at times obligatory, yet for several reasons—I have enumerated some of them in my lecture—it is the very worst kind of transport you can have. Among those are Colonel Gawler, who commanded in Sikkim in 1861; General Graham, who commanded in Sikkim in 1888; General Tregear, who commanded in Lushai in 1889; and Surgeon-General Robert Harvey, who was medical officer of the Lushai Field Force in 1871, and who also referred in his paper on that campaign to the tremendous drawbacks of their coolie transport.

Captain Aplin: May I be permitted to say that I was not alluding to the Indian transport, but to the China coolie transport—not to India transport—which I believe has made very rapid strides, because at one time it was infamously bad. But the Chinese coolie transport is the finest in the world, and is acknowledged by all experts to be so.

The Chairman: We have to thank Major Carter for the lecture which he has given to us. It is one which you will agree with me was admirably delivered and excellently well written, and following the lecture we have had a discussion of not too many speakers, and all of them giving us information which was valuable. The frontier of India to us now is, perhaps, of greater interest than almost at any former time, and we are grateful enough to receive works such as "Where the Three Empires Meet," Conway's "Himalayas," and lectures such as that delivered to us by Major Carter, accompanied by sketches which give to many of us who have not had an opportunity of going to India a greater insight than we ever had at former times of the methods of warfare on the frontier, and also to some extent the appearance and the enormous size of the mountain ranges. I think this Institute, among the many good points which it has, can do nothing to further our knowledge of military history, and also military science, better than by encouraging officers of Major Carter's calibre and knowledge to lecture in this country on India. We have here, in this theatre, men capable of teaching us military art as affecting European nations, but it is somewhat difficult for us to find officers who will come from India, and will give us clear opinions, in which we have confidence, of that country which is to us so all-important, and is, I may say, the keystone of our Empire. It is with these few words I thank Major Carter on my own behalf and on the behalf of those who have listened to him, and on behalf of the Institution, for the trouble he has put himself to in delivering us to-day what I may distinctly say is as interesting a lecture as I have heard in this theatre for some time.

A



THE HAMMOCK STRETCHER USED WITHOUT POLE.

(1) Hammock carried on back. Weight, $3\frac{1}{2}$ to 4 lbs. Bar female bamboo.

(2) Thomas Atkins unrolls the Hammock to carry a wounded comrade down the hillside to the nearest dandi post, or section of Field Hospital.

THE HAMMOCK STRETCHER USED WITH POLE.

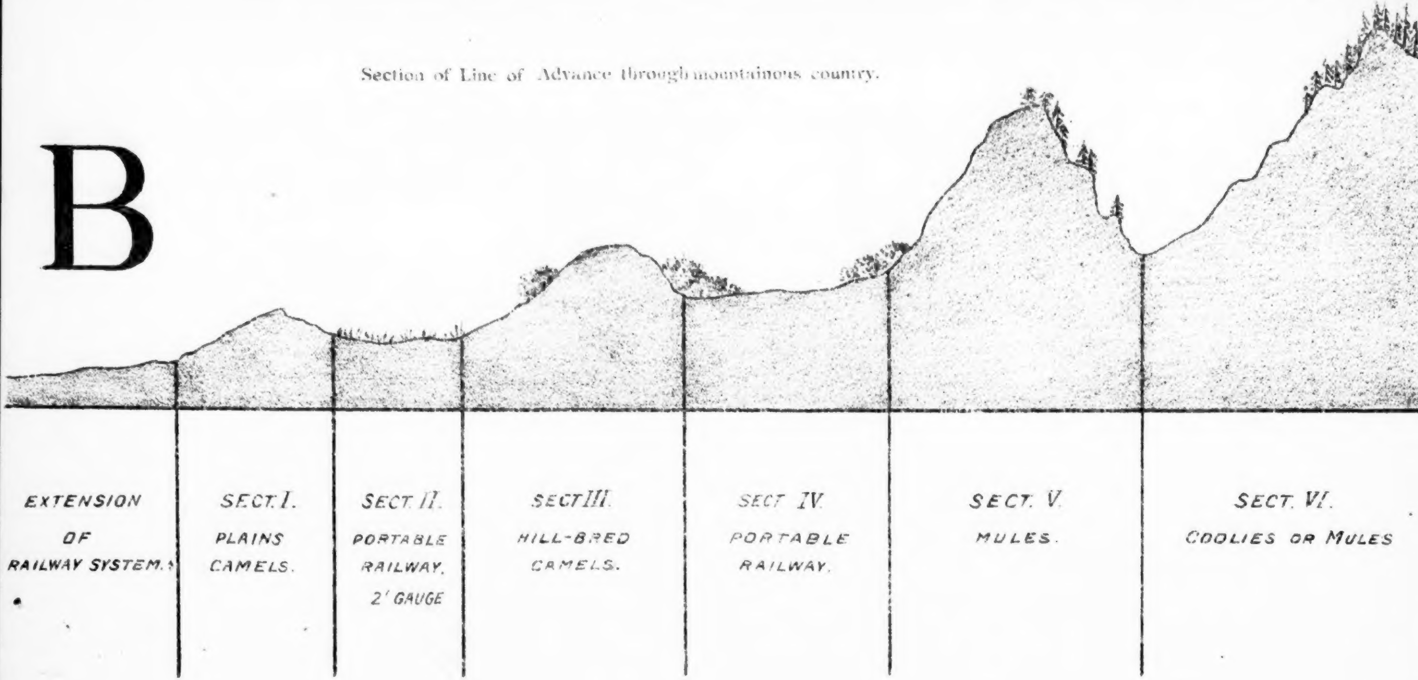
(1) Stretcher folded on to male bamboo 9 feet long for carrying.

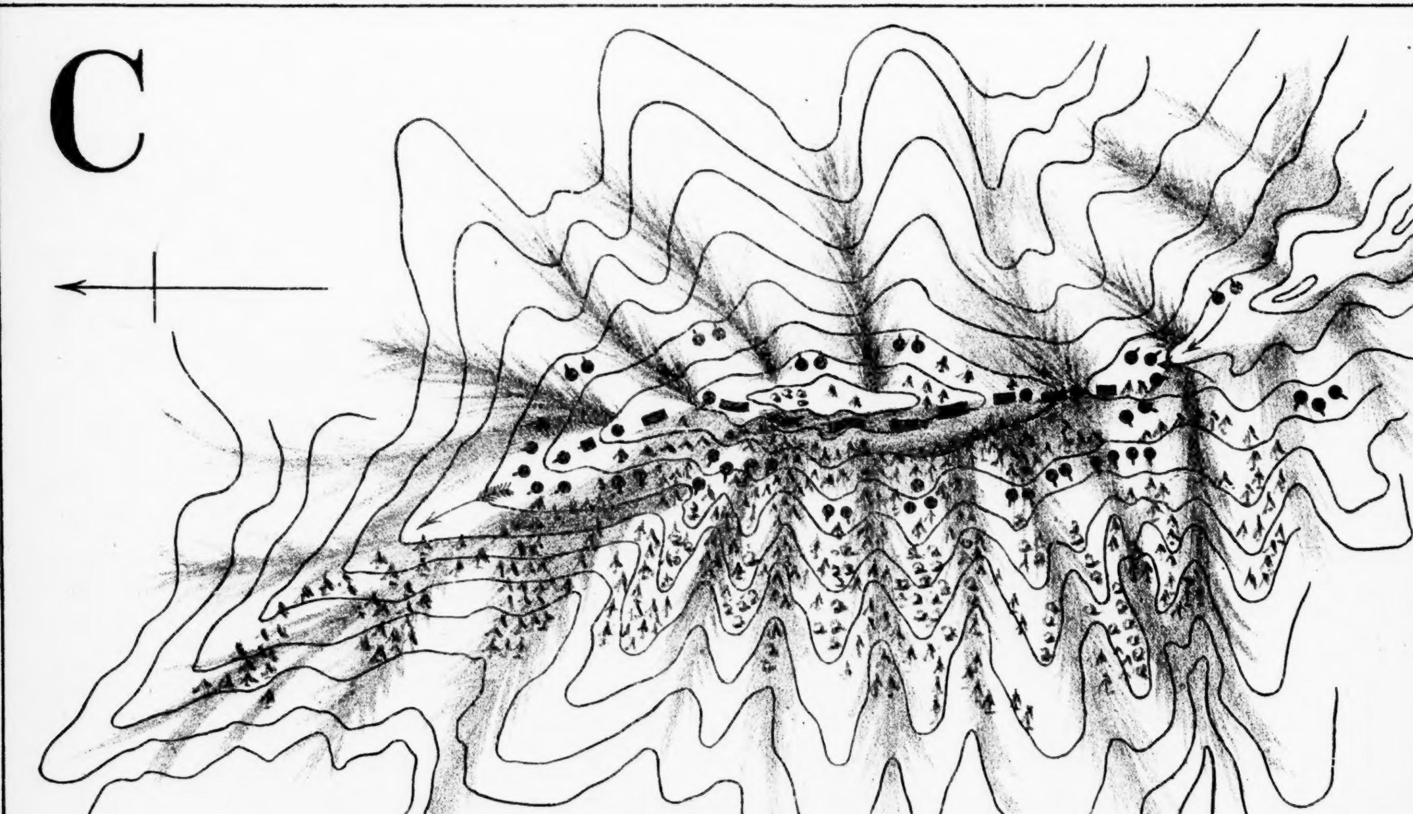
(2) Carrying wounded man down steep hillside.

(3) Hammock attached to pole.

Section of Line of Advance through mountainous country.

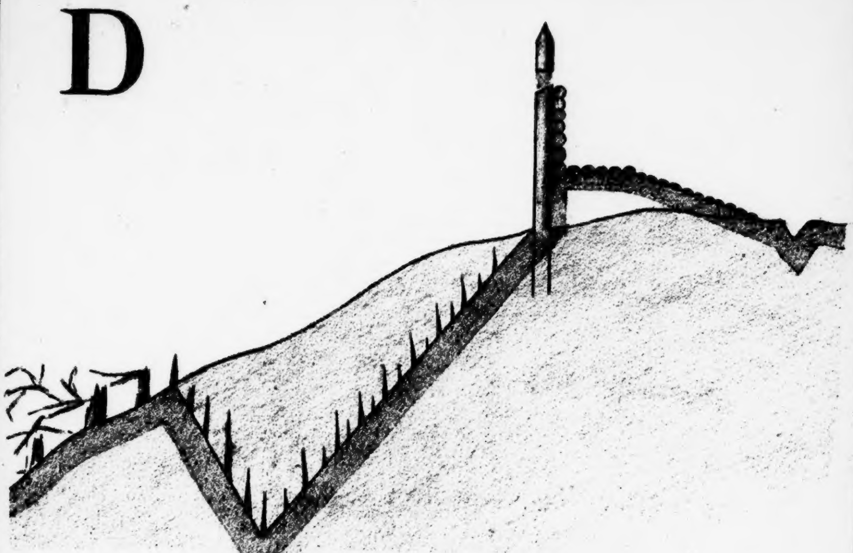
B





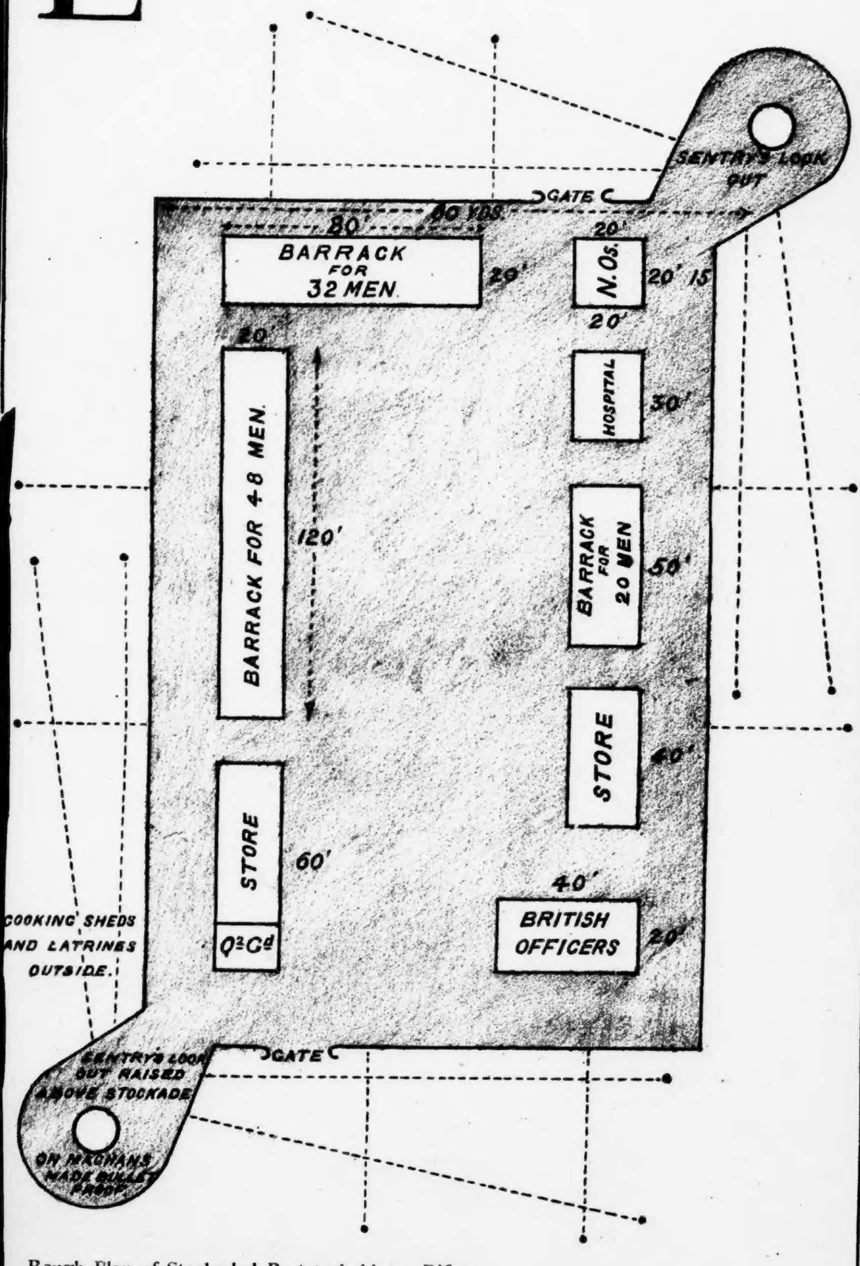
Battalion advancing along mountain ridge, through dense forest, and throwing out stationary flankers from the head of the column, which rejoin it as the rear guard passes them.

D



Profile of part of Stockade at Lungleh Post. Lushai F.F., 1889.
Ditch thickly "panjied"; obstacles on glacis.

E



Rough Plan of Stockaded Post to hold 100 Rifles.
Lungleh. Lushai F.F., 1889.

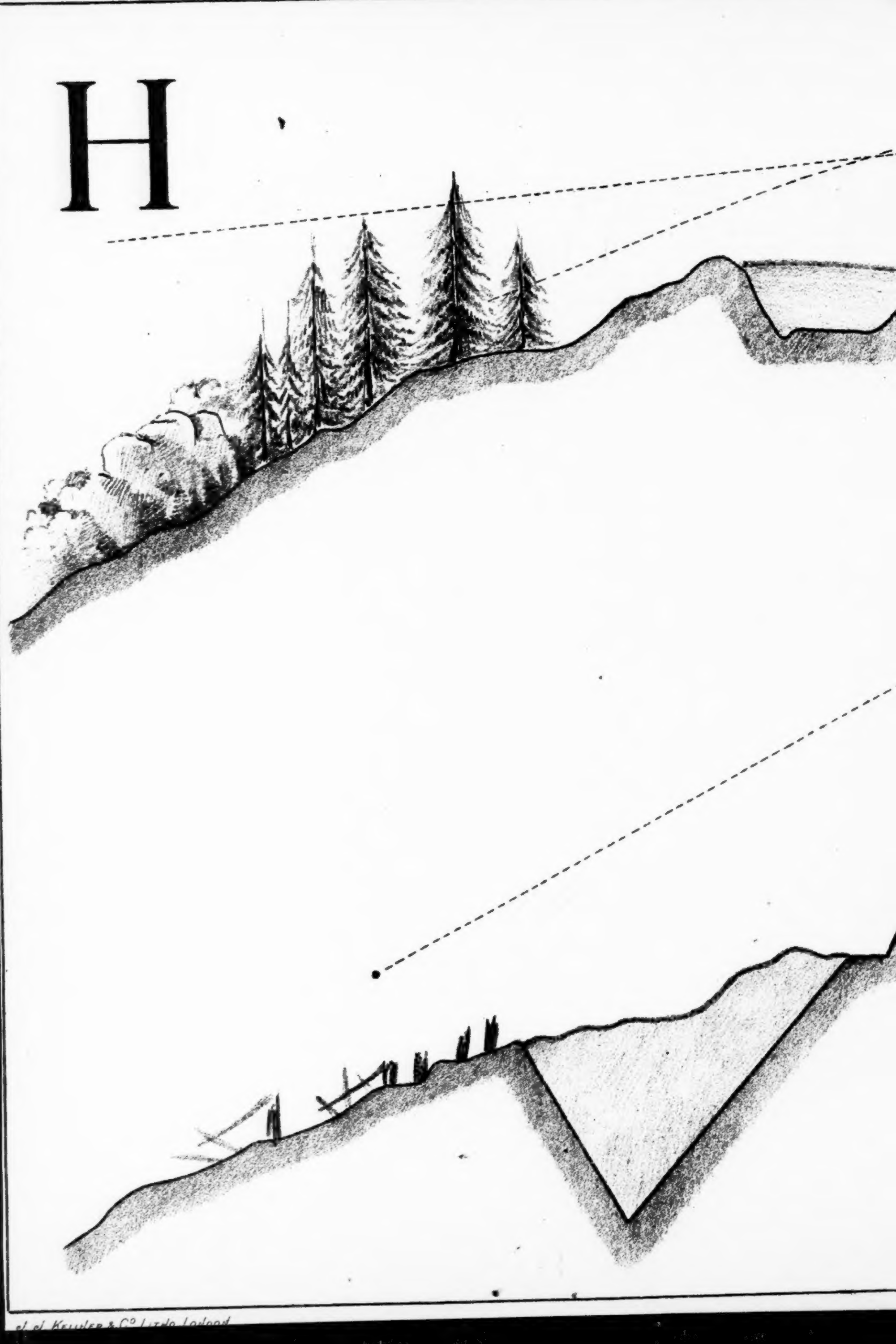
J. J. Keliher & Co. Litho. London.

BAMBOO STOCKADE.

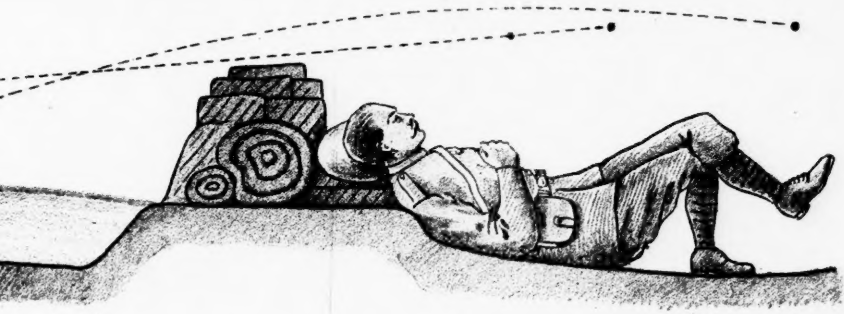
Bayonet Pattern. Lushai F.F., 1889.

G

SUNGAR (STONE WALL) ON HILLSIDE.
N.W. Frontier.

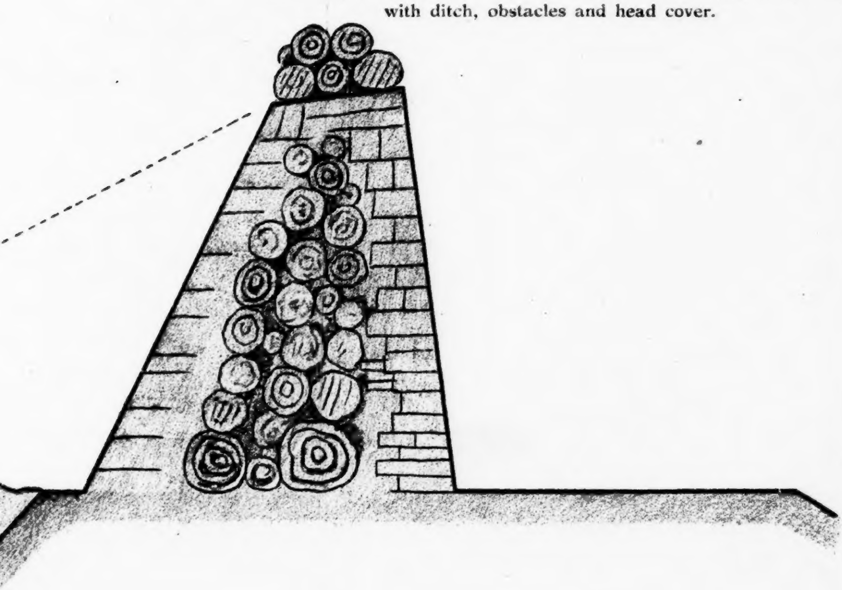


J. J. Keliher & C° Lith. London

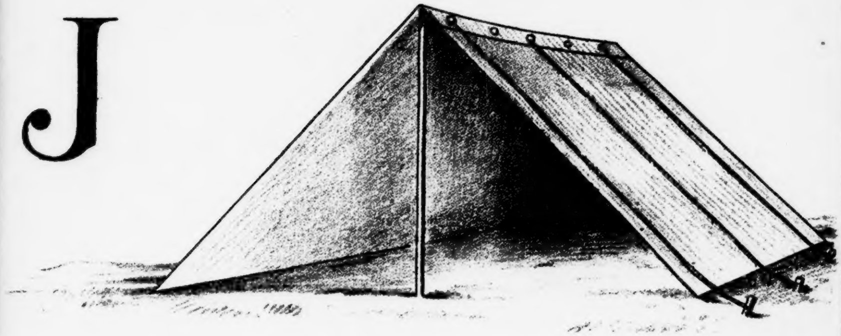


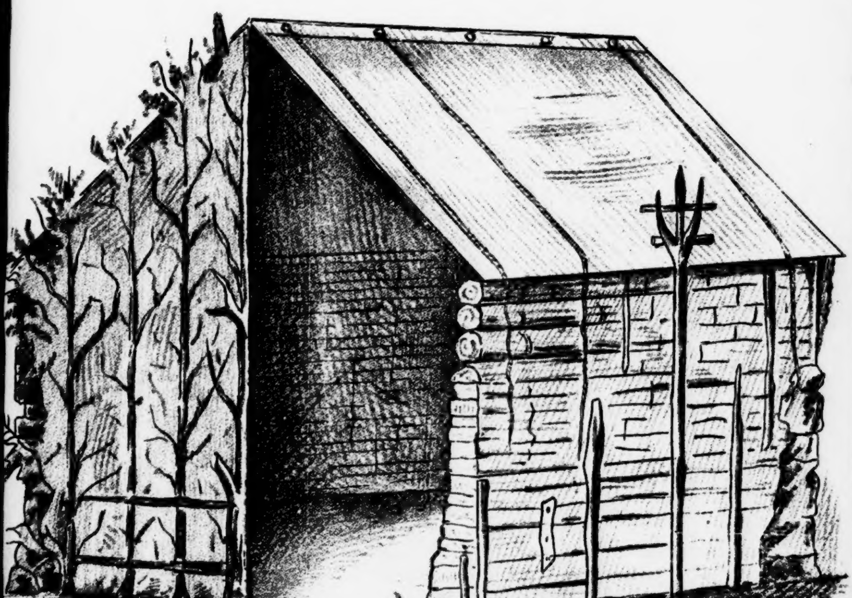
Head Shelter thrown up for the night at Chittabut Peak, H.F.F., 1888, in 15 minutes.

Same improved the next day with breastwork of logs, sods, &c., with ditch, obstacles and head cover.



J





"Shelter" made of two Waterproof Sheets, size 2½ by 1½ yards, to hold two men. Showing how it may be improved when time admits with branches, stone wall, sods, &c.

Copy of one constructed at Seri. H.F.F., 1891.

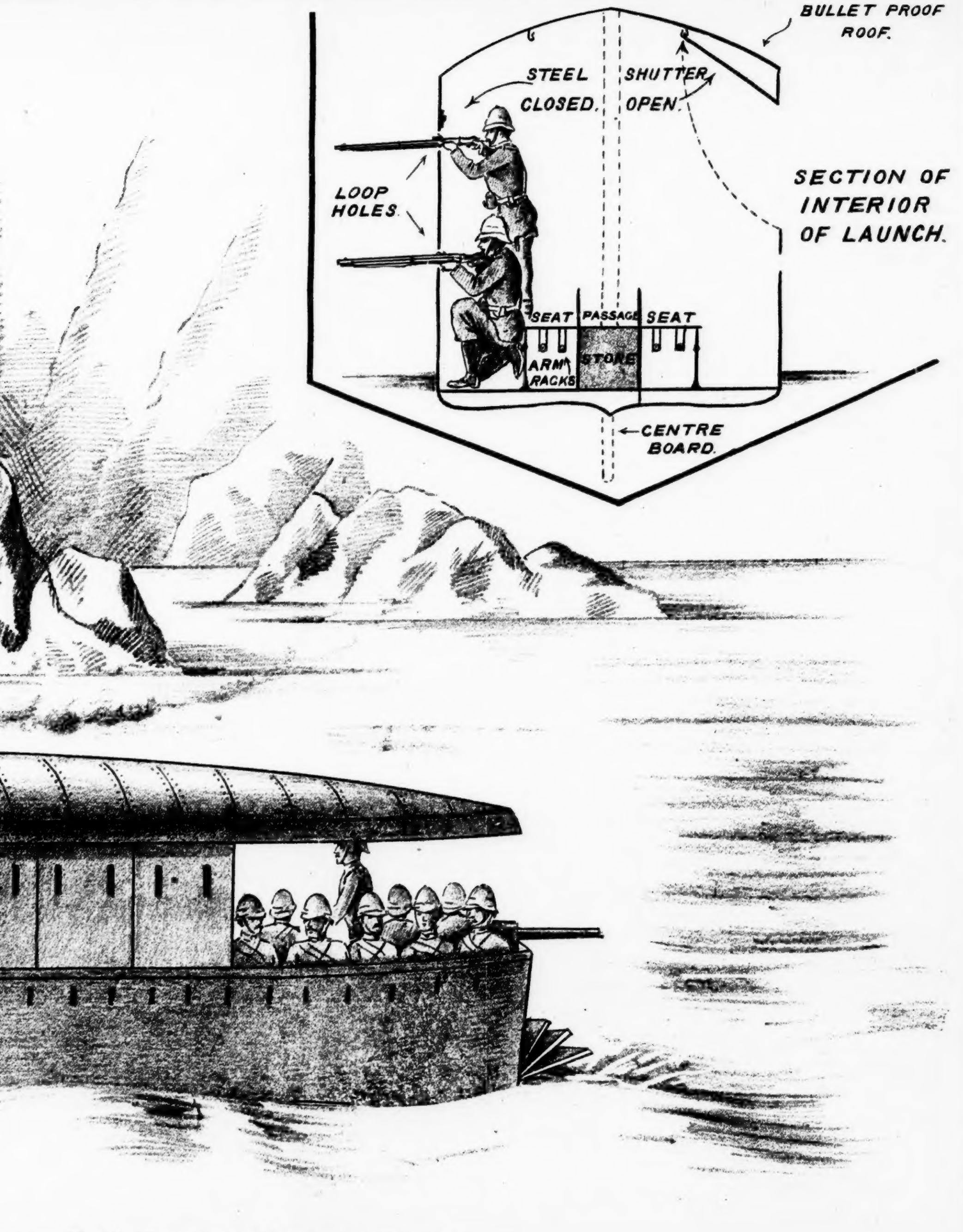
J. Kelher & Co Litho. London.

Journal R.U.S Institution.
Vol XXXIX.

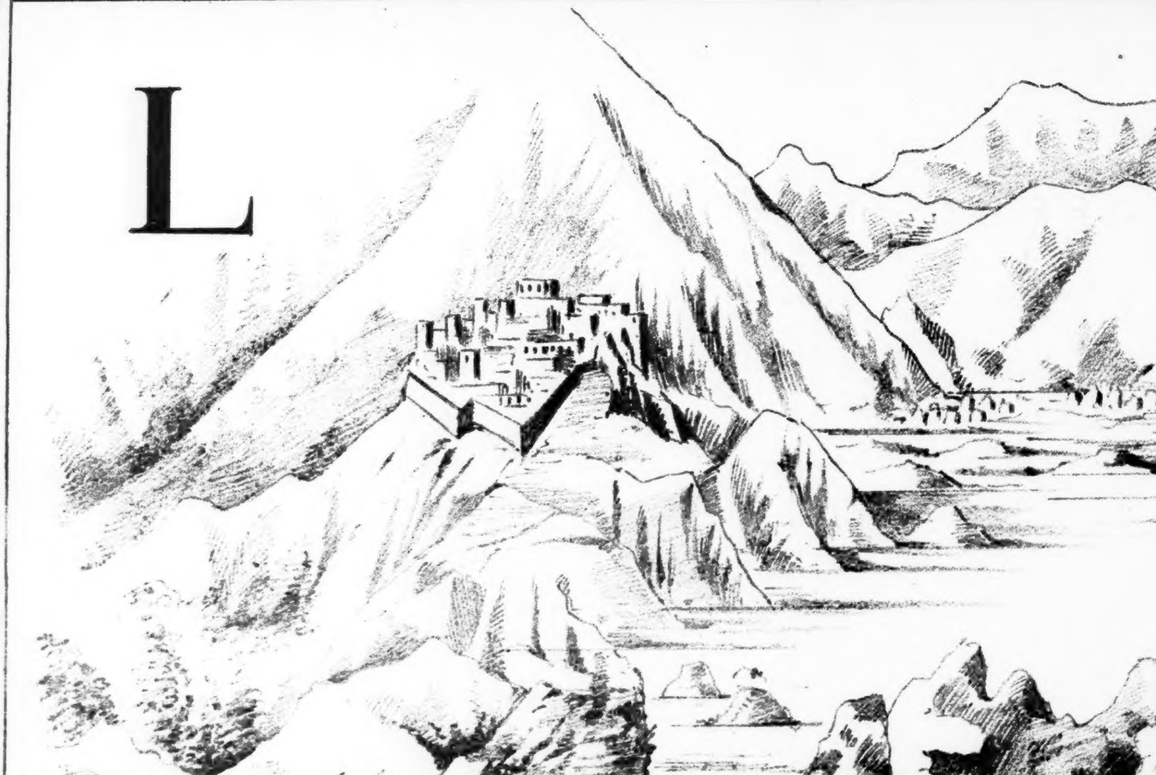
K

Bullet-proof Stern-wheel Steam Launch to hold 20 to 30 Riflemen and tw
to let down all round; almost flat bottomed with centre b
Indus, Kabul and Kurnafuli in t

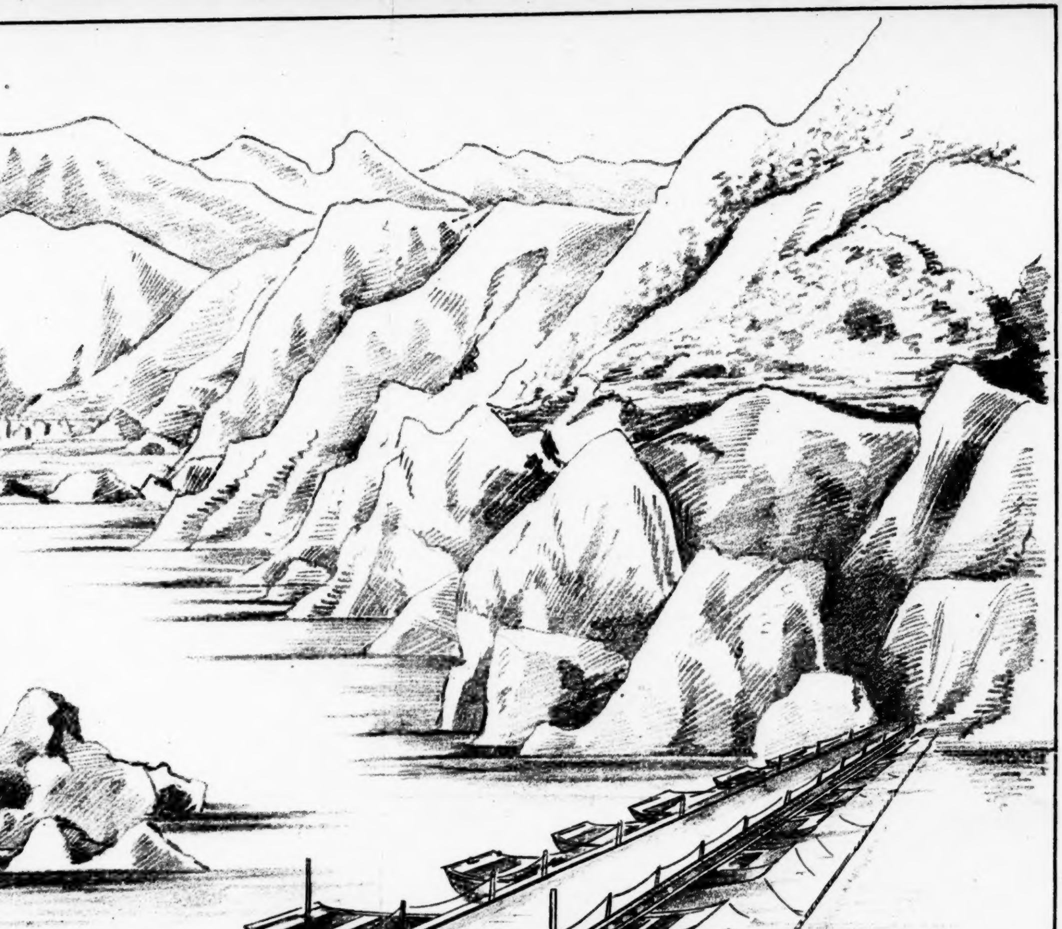
J. J. Keliher & Co Litho London



...nd two Machine Guns ; loopholed and with loopholed Shutters
...entre board. Suitable for use on rivers such as
...uli in the mountains.

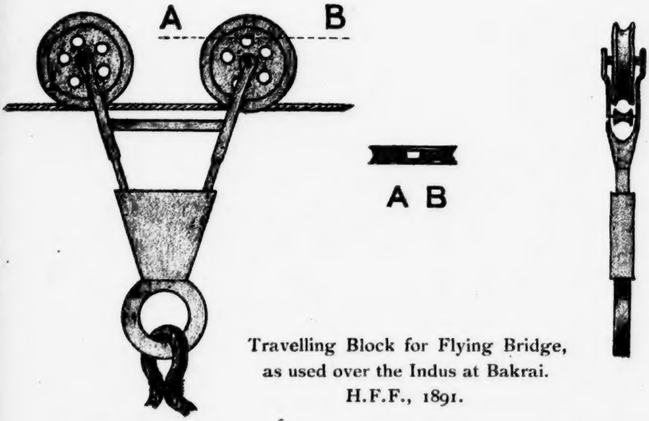


Bridge of Boats over the Indus at Kotkai, H.F.F., 1891, looking south, showing Village of Kotkai and Mahaban Mountain in the distance. 8 boats; roadway of chesses on baulks secured by ribands covered with dry grass and sand; width 9 feet; length 105 yards; current three miles per hour. Took two days to construct.

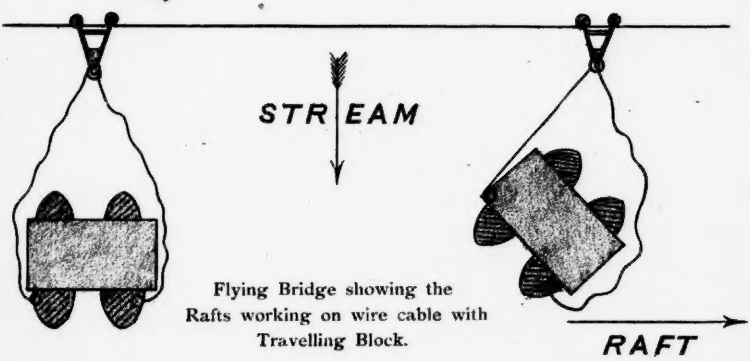


in in

M



Travelling Block for Flying Bridge,
as used over the Indus at Bakrai.
H.F.F., 1891.



Flying Bridge showing the
Rafts working on wire cable with
Travelling Block.

J. J. Kellner & Co. Litho. London

FOREIGN SECTION.

ELECTRIC PROPULSION AND THE NAVAL SERVICE.

From an Article in the "Rivista Marittima," November-December, 1894, by Engineer GIULIO MARTINEZ, Electrician, Italian Royal Navy.

Abridged Translation by Staff Engineer T. J. HADDY, R.N.

INTRODUCTION.—Being strongly persuaded that the employment of electric motors for various services on board our battle-ships must become more and more extended in the near future, any literature bearing on the subject emanating from practical and scientific experts in this particular line will no doubt prove of considerable interest to naval officers generally, and perhaps more particularly to those of the gunnery and torpedo branches of the Service. With this conviction the following somewhat copious extracts have been taken from an article with the above heading in the *Rivista Marittima* of last year, want of space having prevented its earlier publication in the JOURNAL OF THE R.U.S.I. Although the accumulator battery in any form must be cumbersome and require considerable care and attention, there does not appear to be any valid reason why it should not be extensively employed in our larger ships in conjunction with special dynamos for working ammunition and shot hoists, transporting gear, etc., and for ventilating magazines, shell rooms and other compartments in action, or during general quarters. As such motors can be multiplied without difficulty, each compartment might have its own system of upcast and downcast shafts for ventilation on the extraction principle, so ably advocated by Inspector-General of Hospitals and Fleets, J. D. MacDonald, M.D., F.R.S., in his recent lecture at the R.U.S. Institution, thus doing away with the necessity for enormous air trunks through water-tight bulkheads—an undoubted source of danger when any compartment is flooded, automatic bulkhead valves notwithstanding. In fact, electric motors of small size are so simple and easy of application that the various uses to which they might be put to take the place of manual labour in any of our larger ships are practically unlimited, where the power required is intermittent and of only a few hours' duration at most, even if electric propulsion is considered out of the question at present. The whole theory of ventilation by different forms of fans driven by electric motors has been recently treated in a thoroughly comprehensive manner in the *Rivista Marittima*, by Dr. Luigi Pasqualini, one of the directors at the Electro-Technical Laboratory for Torpedoes, etc., at Spezzia, but it is of too technical a nature to come properly within the scope of this JOURNAL, which is concerned more with the practical results than with the abstruse calculations by which these practical results have been obtained. For this reason also the larger part of the purely theoretical side of the question has been eliminated in the following article, although it is hoped sufficient has been retained to make it of interest and value.

THE TRANSLATOR.

ELECTRIC PROPULSION AND THE NAVAL SERVICE.

THE number of electric boats and launches for harbour services has greatly increased during the last few years, and without going into the whole history of the experiments we may admit that the practical era of electric propulsion commenced with the invention of accumulators, which furnished a reservoir much more manageable, light, and powerful than the primary battery, and, what is of more importance, capable of supplying electrical energy at a much cheaper rate.

In Italy, however, we have remained much in the background from various circumstances, and I think I may assert that at the present moment we have no private boat working with accumulators in existence, although it has been proposed to install a regular service of such boats at Venice. The Royal Navy, however, has possessed two electric launches, which were tried several years ago. One of iron, constructed by Messrs. Yarrow in 1887, represented the very best practice at that date, and was spoken of by all the industrial and scientific journals of the year. The other, one of White's 30-foot wooden launches, was fitted in the Arsenal at Spezzia with two electric motors exactly similar to, but more powerful than, those fitted in the Yarrow boat. Both of these were rather in advance of the time, and not being of suitable construction for the service required of them in an element to the exigencies of which electric material had not yet been properly conformed, the results of their trials did not fulfil anticipations, and gave rise to various inconveniences, so that they were at once abandoned. The experiment, however, was not altogether useless, as it served to bring to light many qualities which an electric launch must possess for successful general service, and for war services in particular.

Other navies have from time to time carried out experiments, with no more success however; as with ourselves the types tried do not appear to have been studied with due consideration of the conditions required of them for war services—a fact which fully explains this want of success.

The United States alone has constructed an electric launch expressly for the use of the officers on board, and it has been attached for practical experiment to the "New York." The result of these trials will be watched with much interest, as they will be carried out with the best material now obtainable. I do not, however, believe that electric launches are suitable for service on board ship. In the Royal Navy their application must be limited to special services, which I will mention later, and even for these it is not *a priori* apparent that they are specially advantageous.

This question of electric propulsion, however, is not without its importance for war navies, as there is a weapon of offence which all

Maritime Powers are striving to perfect, namely, submarine vessels, for which, when submerged, no better means of propulsion can be found than the electric motor and the accumulator battery. Whatever may be the importance of electric machinery for war purposes, therefore, a study of the question cannot be out of place in this *Rivista* more especially as up to the present no one has fully treated of it in its various details.

The cases in which the source of electric energy is outside the floating body is very worthy of consideration, but it does not form part of my task to discuss it at length. The current may be supplied to the motors by an aëriel line stretching along the route which the vessel has to follow, a system which is highly suitable for canal navigation, and has already been successfully employed, the methods used being analogous to those followed in the case of electric tramways.

The current may also be supplied by a conductor towed by the vessel herself, as in the case of electrically-propelled dirigible torpedoes. This, however, does not logically belong to an examination into the subject of electric propulsion: its application is confined to dirigible torpedoes, and must form a special argument from this standpoint. We may, therefore, conclude from what we have said that the fundamental characteristic elements of an electrically-propelled vessel are the motor and the battery, and these will both be studied from the point of view of construction, installation, and maintenance. The battery also must be studied as to its power capacity, and the motor as to the conditions under which it works; but before entering into a practical consideration of the question, we must first of all examine them in the abstract: the battery, with regard to its capacity to furnish the energy; and the motor, in regard to its fitness for the work it has to perform under the particular conditions.

I have already observed that the primary pile has given place to the accumulator battery. I need not stop to explain in what an accumulator consists, as it is so well known; but I cannot abstain from pointing out the great inferiority of this apparatus considered as a source of energy, as compared with the usual source of energy in heat engines, that is, the combustible. The electric accumulator is a source, or better, a reservoir, of energy, excessively heavy, and very little work can be obtained by carrying about some tons of accumulators, as compared with what could be obtained by carrying the same weight of fuel. In the installation of accumulators it is necessary first of all to fix the total weight to be carried, and in so doing to take into consideration these two points: the power which has to be developed, and the total work which has to be furnished. As in many other cases in which we have energy in the potential form, the total work which a battery completely charged can yield is not constant, but depends on the power required of it; the total work will diminish with an increased power demanded, and therefore to have good results from a battery, the power for which it is arranged should not be exceeded.

For the most part the discharge of the accumulators in four hours must be considered too rapid. It would be able to furnish half the power

for considerably more than double the time; for example, for nine hours. But in particular cases, in electric launches, and still more in submarine boats, a rapid discharge often becomes a necessity, and for this reason we must choose elements which can support a very high current of discharge. Under these conditions accumulators of the "Planté" type are more suitable than those of the "Faure" type with oxide paste, because they deteriorate less when forced. An "Epstein" element T_9 of a very convenient type for boats can give 65 ampères for two hours, 50 for three, 40 for four, and 25 for eight hours. With these data as a basis it is easy to calculate the weight of Epstein battery necessary for a motor of one useful H.P. This element T_9 hermetically closed, which is indispensable, as we will explain later, weighs 34 kilogrammes, and can yield at the maximum $1 \cdot 9$ volts $\times$ $65 = 135$ watts; admitting the efficiency of the motor to be 80°/₀, it will require $\frac{736}{\cdot 80} = 921$ watts for one E.H.P., or $\frac{921}{123 \cdot 5} = 7 \cdot 5$ elements, having a weight of 255 kilogrammes.

Practically, for 1-H.P. we should have to use 8 elements, and we may say under conditions of forced discharge $\frac{255}{2} = 127\frac{1}{2}$ kilogrammes per H.P. per hour are necessary, using 15 elements for a 2-H.P. motor. A boat having about the dimensions of one of White's 30-foot launches, as used in the Royal Navy, could carry a battery of 60 elements, which would weigh a little more than 2 tons, or as much as the whole of the machinery, including coals and water, when steam is used, and would be able to give 8-H.P. for about two hours. The conditions are, as regards power, much inferior to that given by the ordinary steam motor, and there is the great disadvantage that at least four hours would be required to recharge the battery, whilst to replenish with coals and water would only occupy a few minutes. If we were contented to discharge the above elements at 35 ampères it would last from $4\frac{1}{2}$ to 5 hours, and the power developed under such conditions would be $1 \cdot 9 \times 35 = 66 \cdot 5$ watts; for a useful H.P. on the motor shaft $\frac{921}{66 \cdot 5} = 14$ elements are necessary, or a weight of $14 \times 34 = 476$ kilogrammes. Allowing that the mean duration of the discharge would be $4 \cdot 75$ hours $\frac{476}{4 \cdot 75} = 100$ kilogrammes in weight are required per useful H.P. per hour. A boat of the dimensions above indicated, with 2,000 kilogrammes of battery, and a motor of about 5-E.H.P. would thus be able to travel with certainty for $4\frac{1}{2}$ hours.

Discharging the accumulators in ten hours, that is, at 20 ampères only, and under these conditions allowing the efficiency of the motor, which would be of less power, as 75%, then $\frac{980}{1 \cdot 9 \times 20} = 26$ elements would be required, which would weigh $26 \times 34 = 884$ kilogrammes, or $88 \cdot 5$ kilogrammes per H.P. per hour; the boat could have a motor of $2\frac{1}{2}$-E.H.P. If we compare the conditions of the boat in these three cases, and if we admit, as we may do approximately, that the speed is proportional to the

cube-root of the power given out on the shaft; taking 1 as the speed in the last case, we should have about 1·3 in the second, and 1·52 in the first. *Vice versâ*, given 1 as the radius of action in the first case, we should have this radius as 1·93 in the second, and 3·32 in the third.

These various values established for a type of motor, noted for its relative power and lightness, show eloquently that we need not seek for high speed in electric launches, or, at least, we must be content with a very limited range of action. We see also from these conclusions one of the reasons why, in small boats, electricity can contend successfully against steam, whilst as their dimensions increase the difficulties of electric propulsion are greatly augmented. With increased dimensions motors relatively more powerful are required, a radius of action beyond all comparison more extended, and the waste of time taken in charging the batteries becomes more and more intolerable. In order to extend in reality the application of electricity to navigation, it would not, therefore, be sufficient to find the light accumulators of large capacity after which so many inventors are seeking, but they must also be able to support very high charging currents. With actual accumulators the charging current must be a very moderate one; in general it should never exceed the maximum current of discharge, but for the preservation and efficiency of the battery it is better to use one lower than this. Taking again as our example the Epstein T_9 battery, we see that the charge can be effected under good conditions with 30 or 40 ampères, and the complete operation will then last five or six hours; under exceptional circumstances we might charge in four or five hours with 40 or 50 ampères—that is, the boat we have been considering with Epstein elements must be laid up in idleness for six hours after every discharge.

Now, the periods of discharge under the three conditions examined have been fixed as 2, $4\frac{1}{2}$, and 10 hours, so that the period of idleness will stand in relation to the periods of service as 3, 1·26 and ·6. These proportions will become lower in practice, as in many cases we should have also to include in the period of effective service certain intervals of inaction. The idea of a spare battery to exchange for the one exhausted is not practicable, except in the case of a very small craft with six or eight accumulators; the case is very different when there are some dozens of them, and these of no light weight. I propose to show presently that it is useful to have accumulators of moderate size, which necessitates a considerable number of them and a large number of connections to break and re-make, as we cannot connect them permanently in groups as in the case of electric cars. In boats, especially for service, the compartments for the accumulators must be well protected, and considerable work would be entailed in opening and closing them, so that it would probably save time to charge the accumulators in place when properly installed and secured, rather than to change them. In any case special arrangements would be required for the work, so as not to injure the elements, and a proper building on shore for storing the spare batteries. It will be seen, therefore, under any point of view, in order to augment the co-efficient of

usefulness with respect to time, we must have a slow discharge of the battery, especially when electric launches are run for profit on lakes and rivers ; that is to say, we must be content to reduce the speed to about 5 or 6 knots—a speed however that very small steam-boats rarely exceed. Further, when we decide to completely give up the idea of rapid discharge, it will be easy to form the battery with light elements without compromising the duration of discharge.

It would be possible to obtain a battery capable of giving out more work than the Epstein of equal weight, but it would not be easy to find one which at the same time would afford equal guarantee of durability. We often find in manuals and treatises on accumulators details as to weight, etc., which are not even approximately correct; it will be well, therefore, to give some data with regard to light, transportable accumulators for purposes of traction and navigation, as constructed by various firms and guaranteed by them, and some of which, for example, the Tudor, E.P.S., Julien, and Epstein, have been tested by numerous trials, and found correct.

Type.	Capacity in Ampère hours.	Current of discharge in Ampères.	Duration of discharge in hours.	Weight of Sealed Element.
Laurent-Cély ...	150	35	4·30′	32 kilos.
Tudor	120	35	3·25′	36 ,,
	105	45	2·20′	36 ,,
Julien	170	35	4·45′	25 ,,
Electrical Power S.	170	35	4·45′	34 ,,
Hagen	180	18	10·0	42* ,,
	160	23	7·0	42* ,,
	114	38	3·0	42* ,,
Epstein	190	25	7·40′	34 ,,
	175	35	5·0	34 ,,
	130	65	2·0	34 ,,

* Without acid, and not sealed.

It will be useful to add some information relative to the Waddell-Entz accumulators with oxide of copper and alkaline solution. These accumulators have an E.M.F. of ·85, and it is to be noted that those constructed by Gommalines et Desmazures of this type for the French submarine boat "Gymnote" were afterwards abandoned on account of the constant internal short-circuiting, and accumulators of lead were substituted. It appears that in America these defects have been overcome, as after some months' trial of them in an electric car several others were similarly fitted, and a regular service instituted at New York. According to the makers, elements capable of discharging 80 ampères for 4 hours 20 mins. weigh $12\frac{1}{2}$ kilogrammes each; if each element can give $\cdot 85 \times 80 = 68$ watts, then 14 elements will be sufficient for 1-H.P. with a motor having an efficiency of 80%. We require, therefore, 175 kilogrammes per H.P., and $\frac{175}{4\cdot 33} = 40\cdot 5$ per H.P. per hour. If these data are correct, there will be a notable advantage as regards weight in using this accumulator, and on the boat previously considered

we should be able to place 160 elements (about 2 tons) and obtain 125 volts, and 80 ampères for more than 4 hours, or 10·6-E.H.P. on the motor shaft. If they give no more trouble than ordinary lead batteries, these alkaline accumulators will, no doubt, be extensively employed in electric navigation.

The accumulators of lead have many defects, particularly those of the transportable type, in which to gain volume and weight the plates have been unduly reduced in thickness, or, worse still, brought too close together. I consider that the distance between the plates should be absolutely never less than 6 millimetres, and that this distance should only be accepted when the distance ridges, tubes, or bosses, which keep the plates apart, are very numerous. I should always choose elements of which the plates were 8, 10, or even 12 millimetres apart; the distance must be greater the larger the plates composing the battery; larger in those types with oxide paste, and also in those types with rigid plates, which become deformed, and which it is not possible to straighten without dismounting. The plates should be kept at least 20 millimetres from the bottom of the containing vessel and supported on strips of wood or ebonite when they cannot be supported entirely separated from it. The plates of the same polarity should form a solid and perfectly connected system, and be kept separated from those of opposite polarity by efficient means; india-rubber rings as used by some makers do not offer sufficient security. In America perforated diaphragms are exclusively employed, but forked or toothed projections properly disposed constitute an excellent system of mounting, and as I have said the mounting of the plates must be the more accurate the more liable they are to bend; in general we may say that perfection in mounting contributes more to the success of the accumulator than the substance of plates themselves. Elements with plates apparently ruined, and which frequently drop the active material, may work perfectly when mounted in such a manner as to prevent short circuiting; and, on the contrary, the newest of elements if mounted too closely, or in such a way that they cannot expand and must, therefore, bend, may be rendered unserviceable by a single abnormal charge.

The Julien accumulators, with a view of considerably augmenting the capacity of the battery, are often mounted with plates too thin and too close together, with the result that they are easily injured, but not through defects inherent to the plates, as when properly mounted they are amongst the best manufactured. I believe, however, if we wish to secure for the elements a mounting comparable to that of the Tudor or Epstein, the difference in weight which exists between the Julien elements and other systems with equal capacity according to the table, would disappear altogether, even in the highest of them.

The weight of the heavy Tudor accumulators, and the excessively heavy Hagen, is due exclusively to the thickness of the plates used and the moderate current required for their good preservation.

In order to definitely fix the choice of the battery we must have regard to the total number of elements, in order that we may have no

difficulty in charging them with the dynamos at our disposal. To charge a lead element a difference of potential of about 2·5 volts is necessary, and to charge a series of S accumulators we must have at least 2·5 S at the dynamo. If we have a dynamo with a D.P. of E volts, we can charge in series $S = \frac{E}{2 \cdot 5}$ accumulators, and as we can charge a certain number of these series in parallel we shall be able to construct the battery of a number of elements which is a complete multiple of $\frac{E}{2 \cdot 5}$. If, for example, the dynamo in the Royal Navy is used to charge accumulators, we shall be able to charge groups of $\frac{65}{2 \cdot 5} = 26$ elements; in order to allow some margin and to permit a certain fall of potential in the line, it would be better to arrange not more than 24 elements in series, so that, if electric launches should be given to our battle-ships, they ought to have 24, 48, 72, 96, or some other number of elements which is a multiple of 24. . . . . . Now, where there are electric light stations, there would be no difficulty in establishing special dynamos for charging boats' accumulators—dynamos which could be worked in many cases without any addition to the *personnel* of the station, and with relatively little expense.

These dynamos should give $2 \cdot 5 S$ volts if S is the number of elements in series in every group to be charged, and PA the ampères, if there are P groups to be charged in parallel each with A ampères. On every group there should be a regulating rheostat of small resistance, and an ammeter or, better, a registering ampèrometer. The necessity of charging the various groups of the same battery equally, and the constant vigilance required in consequence, make it preferable to charge normally all the elements of the same battery in series, using a special dynamo. The same necessity of discharging the various elements of the battery equally renders it preferable, when this can be done, to discharge all the elements in series simultaneously.

It is very difficult to preserve the various elements of a battery rigorously in the same conditions of charge, especially when composed of groups in parallel; if in changing the connections and the grouping we put in parallel groups differently charged, those at the higher potential will discharge into the others; we shall have perturbations and diminutions of output, and it will be very difficult to know exactly the state of charge of the battery, for the elements being hermetically sealed it is not easy to judge by measuring the density of the electrolyte, as is generally done with fixed batteries. In order to maintain a certain uniformity in the potential of the various elements it will be well to avoid a complete discharge, and to prolong the charging somewhat beyond what is usually considered necessary and sufficient. But with the increase in the size of the battery, and the importance of the installation, we cannot do other than have recourse to groups in parallel, because it is not practicable to supply the motors at too high a potential. We must maintain that a difference of 300 volts is rather too high, and that

144 to 160 elements in series represents the maximum compatible with the insulation obtainable at sea. To such potentials we must arrive, however, in submarine boats when we have batteries of some tons in weight; but it is not necessary in the case of launches which at their maximum speed would not require more than 180 volts, for it would be difficult to take on board more than 100 elements in boats of ordinary dimensions.

When there are various groups of elements permanently united in parallel we may always suppose we have in them a single group of elements of larger dimensions, so that in any case we may say that the maximum difference of potential at our disposal is that which can be obtained with all the elements in series. We can then arrange for a difference of potential equal to half, quarter, one-third, or one-sixth, dividing the batteries successively into two, four, three, or six groups. Beyond these sub-divisions it will not be well to go in practice, and in the case of launches when this sub-division cannot be altogether avoided it should be limited to that of two groups only. After what we have said on the advisability of discharging all the elements equally, it is clear that the possibility of supplying the motor with a larger or lesser number of elements, by excluding some of the series, should not even be considered. Nothing can justify the adoption of such an absurd system for regulating the difference of potential in the case of electric propulsion, where the conditions are essentially different from those of a central station for illumination.

Further on, I will consider the practical qualifications for the elements of a battery for electric launches; and now, knowing the theoretical elements of the battery which we can employ, I will occupy myself with the motor to which it can be applied. Supposing that the battery is composed of N elements each capable of discharging to I_0 ampères, the maximum difference of potential being $\Delta_0 =$ about $1{\cdot}9\ N$, the motor should absorb at the maximum $W_0 = \Delta_0\ I_0$ watts. From what we have said on the advisability of keeping the battery with all the elements in series, we must also hold that in the condition of maximum power the motor should absorb W_0 watts with the difference of potential Δ_0 and current I_0, and not, for example, with the difference of potential $\frac{\Delta_0}{2}$ and a current of $2I_0$ . . . . I will now show how the conditions of working corresponding to various differences in potential can be determined in any case, and how we can calculate the rheostat for obtaining any reduced velocity whatever; it is, in fact, clear that if we are able to construct a motor to work with Δ_0 volts I_0 ampères and n revolutions, we must accept all the other conditions of working due to the construction of the motor itself, and to the value of the constant p, relating to the hull and propeller, and which is within certain limits proportional to the pitch of the latter.

An examination into all the possible conditions of working for an electric motor, and the consequent determination of the proper value

of the co-efficient p, does not offer any difficulty, and can be conducted in accordance with rules more or less explicitly laid down in any electrical treatise; I will limit myself here to showing how it can be done in a convenient manner for an electric launch motor. Having had the opportunity to prove an Oerlikon motor for boats in this way, I will here give the measurements taken with a view of rendering the general process which can be carried out in the case of motors in series more evident.

The motor in question is required to fulfil the following conditions of normal working:—

Volts at the poles	125 to 130
Ampères	35
Revolutions	450 to 480 per min.
E.H.P. on shaft	4·5

This is equal to a required efficiency of about 76%.

The motor has a simple magnetic circuit of the Edison-Hopkinson type, with drum armature and carbon brushes normal to the collector, fixed in an invariable position. The resistance of the armature cold is ·211, that of the series coils ·228, the total resistance, including the brushes, when hot is about ·50, a mean value which I shall consider as constant.

For simplicity of notation, treating of motors in series, I shall indicate the whole resistance of the motor with R, rather than that of the armature alone, and with Δ the difference of potential at the poles rather than at the brushes, so that there will be no modification in the given formula. The "Pasqualini" magnetic brake is applied to the motor (see the *Rivista*, of September, 1892), and made to work with different charges, reading off the volts at the poles, the ampères absorbed, the number of revolutions, and measuring the useful moment of rotation corresponding to the various conditions. The values found resulting from a long series of measurements are given below, and from these series of measurements the values of $\epsilon = \frac{\Delta - IR}{n}$ are calculated.

Δ Volts.	I Ampères.	n Revs. per Min.	C Useful moment in Kilogram-meters.
25·5	5·15	472	0·0
49·0	10·3	451	0·527
59·0	12·65	459	1·125
75·5	15·0	495	1·687
84·5	17·5	492	2·250
88·0	20·4	443	3·150
96·0	23·0	431	4·050
93·0	25·5	382	4·950
103·5	28·2	397	5·850
107·5	31·8	392	6·880
106·0	35·5	365	8·365

The values of $\epsilon = \frac{\Delta - IR}{n}$ are introduced into the curve as a function of I, remembering that ϵ (proportional in value to Z the useful magnetic flow of induction) depends only upon I; the curve of

useful moment C is also traced in functions of I. These curves are shown in Fig. 1 at $\epsilon\,\epsilon$ and $C\,C$; the points corresponding to the numerous observations taken are marked in the diagram. Compensating for errors of observation, the mean value of ϵ and C corresponding to the various values of I are deduced from these curves, and we can construct a table of the corresponding values of these three factors such as the following:—

I Ampères.	ϵ Volts.	C Kilogram-meters.
10	·094	·58
14	·128	1·38
18	·161	2·44
22	·190	3·64
26	·214	4·98
32	·231	6·38
36	·248	8·52

The preceding table which we can compile for all the values of I enables us to reply to the question, What electrical energy must we supply to the motor in order that it should develop a useful moment, for example, of 4·98 kilogram-meters, and have a speed of 320 revolutions?

We find in the table that the current for a moment of 4·98 is 26 ampères; the counter E.M.F. corresponding to 26-ampère excitation is ·214 volt for each revolution, that is $·214 \times 320 = 68·5$ volts at 320 revolutions. The total resistance of the motor being ·5 ohm the difference of potential at the poles must be $68·5 + (26 \times ·5) = 81·5$ volts; and if the curve $C = \phi\, n$ is known, which can only be determined accurately by experiment, but for small speeds is approximately of the form $C = p\, n^2$, p being as before a constant for the hull and propeller; we shall then be able without any trouble to obtain the number of volts and ampères of current which the motor will absorb for every number, n, revolutions of the screw.

In the particular case we are considering, giving to p the value which follows from assuming as a possible condition of working that with 35 ampères and 450 revolutions, we can complete the working diagrams for our motor.

The useful moment for 35 ampères is 8·10, therefore the value of p is given by $8·10 = p \times 450^2$ or $p = ·000040$. It is not necessary, however, to calculate this value of p; it is more convenient to use graphic construction. In the figure which gives us the curves $\epsilon\,\epsilon$ and $C\,C$, let us add the parabola $C = p\, n^2$, using for the ordinates the same scale as that of the moments for the curve $C\,C$, and choosing a convenient scale for the number of revolutions. We have one point of this curve, that of the abscissa 450, and of the ordinate 8·10; we can therefore construct the parabola geometrically, of which the axis and the tangent at the vertex are known, by means of some of the well-known properties of the curve. In the diagram Fig. 1 this curve is represented by $C'\,C'$. After this it is very easy to find how many volts

and how many ampères are necessary to make any number of revolutions less than 450, or even rather more than 450, because we can prolong the curve somewhat beyond the observed limits. If we wish, for example, to know the volts and ampères necessary for a speed of only 250 revolutions, find on the curve $C' C'$ the point P of the abscissa 250, a parallel drawn from this point $x_1 O_1$ meets the curve $C C$ in O_1. The ordinate of P which is that of O_1 gives us the moment corresponding to 250 revolutions; the abscissa of O_1 gives us the intensity, which is 18·3 ampères. From the point O_1 draw $O_1 y_1$ parallel to the axis of the ordinates meeting the curve $\epsilon \epsilon$ in Q. The value of ϵ corresponding to 18·3 ampères is ·16 volts, whence the counter electro-motive force is $·16 \times 250 = 40$ volts, and the necessary difference of potential is $40 + (18·3 \times ·5) = 49·2$ volts, which is about the third part of the difference of potential necessary for 500 revolutions, and which are given by about 150 volts.

We can at once notice that if our motor works at full power with 78 or 81 elements in series (about 150 volts), and with 30 ampères, we shall be able to obtain a condition of working sensibly equal to half-speed, by arranging the battery in three groups of 26 or 27 elements each, connected in parallel. Collectively the three groups would discharge about 18 ampères, and each element would give a current of about 6 ampères; the Epstein T_9 accumulators could discharge under these conditions for more than 32 hours.

Finding the volts and ampères necessary for various speeds, we can eventually construct a diagram having for abscissæ the number of revolutions, and for ordinates the volts or ampères. This diagram contains the results of the experiments carried out, and will serve for various purposes in practice, for example, for calculating and constructing the rheostat for the regulator. Fig. 2 gives this diagram for our motor with the value $p = ·000040$; it is clear from what has been said that this diagram varies with a change in the curve of resisting moments. Later on I shall return briefly to these diagrams, in order to discuss various questions relating to motors.

It will not be always possible to determine experimentally the curve of effective moments of the motor. To do this it is necessary to have at disposal a dynamometer brake, and it is not easy to make a long series of measurements with a simple frictional brake, as we can with an electro-magnetic brake with an approximation certainly within 1%; on the other hand, not everyone can have such a brake at their disposal, especially for considerable powers. For this reason in most cases we must calculate the motor moments by the formula $C = ·974 \epsilon I$.

The trials with motors in series will be limited to the construction of the curve $\epsilon \epsilon$, of which as many points as possible must be found by a series of measurements with increasing, and another series with decreasing, intensity. We must naturally have some means of varying the load on the motor-shaft with facility, and, if possible, continuously; a dynamo serves this purpose admirably. We do not make dynamometer measurements, however, but read off on the instruments volts, ampères,

and revolutions, corresponding to various conditions of load. We also make a trial unloaded, or better, a series of unloaded trials, at various speeds, and we shall see that the motor absorbs a current I, sensibly constant within wide limits of speed, the moment of friction being constant.

If we deduct this moment $C_1 = {\cdot}974\ \epsilon_1\ I_1$, which yields no useful effect, from the total moment of the motor, we shall have a moment which will still differ from the effective moment by the moments due to Foucault currents and the phenomena of hysteresis.

This difference we can only establish by experiment, that is, by comparing the theoretical and effective moments; but as it cannot be great in a good motor, the calculated moment, with a small convenient reduction, will serve very well indeed, instead of the effective moment, in these calculations.

The Oerlikon motor under consideration worked unloaded under the following conditions:—

Revolutions.	Ampères.
230	4·98
333	5·20
441	5·00
531	4·95
645	5·30
759	5·25

The increase of current at the highest speed is, in truth, very slight. Taking account of the fact that in the laboratory experiments the lubrication was particularly cared for, the collector scrupulously clean, etc., we may take as the constant value of the intensity corresponding to the moment of friction one of the highest values; for example, 5·25 ampères. Since corresponding to such intensity $\epsilon = {\cdot}05$, the calculated moment of friction will be

$$974 \times {\cdot}05 \times 5{\cdot}25 = {\cdot}260.$$

Taking this constant moment from the motor moments calculated, as we have said, corresponding to the various intensities, we can make a comparison in our case between the calculated moment, neglecting parasitic effects, and the observed useful moment. In the following table are some of these values relating to observations made with the Oerlikon motor:—

Intensity I	Calculated Moment C_1	Effective Moment $C\ eff.$	Difference $C_1 - C\ eff.$
10	·656	·580	·076
14	1·490	1·380	110
18	2·563	3·440	·123
22	3·810	3·640	·170
26	5·165	4·980	·185
30	6·500	6·380	·120
34	7·790	7·760	·030

From this table we see that the mean difference $C_1 - C$ *eff.* is very small, and the percentual error not greater than that which might be committed in measurements taken with the Prony brake, a very difficult operation with a rapid motor subject as is an electric motor in series to quickly change its speed with a variation in the resisting moment. . . . The characteristic diagram obtained will serve for an examination of the question whether we can with greater or less inconvenience overload the motor, and of the power to change the co-efficient p. If the motor has been really constructed for a certain condition of working with a minimum of weight, it is supposable that the working condition is the maximum which can be got out of it. But in many cases the motor has not been duly studied to this end, the makers having simply modified the winding of their particular type, for dimensions and working conditions to suit the requirements as nearly as possible; in other cases the firm has sent a motor required for work at slow speed, which could work at a considerably higher number of revolutions at its normal speed with the same intensity of current. Now, in proving a motor it is well to fix the limits of the factors of maximum load, or maximum intensity of the armature, and the maximum number of revolutions.

From the size of the winding, the particular construction of the motor, and better still by a practical proof, we can obtain the maximum current which can traverse the armature or the magnets without producing excessive heating even on prolonged service. From an examination of the shaft and its supports, the construction of the armature and magnets, we can judge the maximum number of revolutions which will be compatible with good working. In our case we see that the armature being constructed with wire of 2·5 $^m/_m$ diameter gives a sectional area of 9·81 $^m/_m{}^2$ for the passage of the current, which corresponds to 3·57 ampères per $^m/_m{}^2$ when working with 35 ampères. A current of 4 ampères in the armature winding would not be excessive in treating of a relatively small motor, and for this reason we may reckon on prolonged efficiency, even with 40 ampères.

As regards the number of revolutions, the bearings in this particular case would not permit of a large increase, but would certainly work well at a normal speed of 550 revolutions, and under exceptional circumstances with careful lubrication at 600. The perfection with which the armature is constructed would permit of a very much higher angular velocity, and with a modification of the support and the adoption of automatic lubrication would allow of a normal speed of 800 revolutions.

The diagram (Fig. 2) shows us that at the velocity of 500 revolutions the motor would require 150 volts and 40 ampères, always supposing that $p = \cdot 000040$. These would be very possible conditions of working, but it would perhaps be better to change the co-efficient (p) somewhat, and arrange, for example, to work with 150 volts and 37 to 38 ampères; the number of revolutions will be just over 500. In other cases it might be convenient to assume for p a value quite different from that originally laid down.

The above considerations show the great adaptability of a series motor for working with different values of the co-efficient p; it is only necessary not to exceed the maximum current which the motor can support, and to have a good mechanical construction which will permit of very high velocity of rotation, and the motor will work very well indeed with either an increase or decrease of p from that originally intended. If the screw has too fine pitch, and therefore p less, the motor will make more than the designed number of revolutions, and if the pitch is too coarse the motor will make a less number; but in consequence of the relations which exist between revolutions, moment, and intensity, the variations in the useful power developed will not be great; less than in the case of a shunt motor, in which a variation in the co-efficient p would not produce any sensible variation in the number of revolutions.

With too great a pitch of propeller the armature might easily be traversed with an excessive current; with too small a pitch the useful effect would be greatly diminished, for the reason that the moment of resistance would not diminish with the speed in the former case, nor increase with it in the latter. The motor in series may, therefore, be advantageously employed for varying conditions. This is not the case with a shunt motor, the conditions of working of which we will now consider graphically, although we are not able to do so experimentally.

We have to construct a diagram analogous to that constructed for the series motor, but the problem is a more complicated one. In the case of the series, we have obtained by experiment the curves $\epsilon\, \epsilon$, $C\, C$, $C'\, C'$ of the volts for one revolution in functions of the intensity, of the useful moments in functions of the intensity, and of the moments of resistance in functions of the number of revolutions. The possible conditions of working are determined (Fig. 1) by a couple of movable axes $O_1\, x_1\, y_1$ which may be applied to the co-ordinates with the origin on the curve $C\, C$, and the co-ordinates of the points of intersection of $O_1\, x_1$ and $O_1\, y_1$ with the curves $C'\, C'$ and $\epsilon\, \epsilon$ give us, or permit us to calculate, all the elements of the working performance of the motor. In the shunt motor it is much less simple, because the curve $\epsilon\, \epsilon$ does not only depend on a single variable condition, but depends on the differences of potential at the poles, and on the intensity of the current in the armature. For this reason it is necessary to make a series of measurements at constant potential, but different in the different series, varying the load on the shaft in each series, or the intensity of current in the armature. When the potential at the brushes is constant, the number of revolutions n, the magnetic flow Z, and consequently the motor moment also, depend altogether on I. Varying the load of the motor, noting the ampères and revolutions (the volts are constant) and the useful moment if possible, we can construct a diagram of the working conditions.

In Fig. 3 are represented the curve of revolutions in functions of

the intensity, the curve of motor moments $C\,C$ in functions of the intensity (observed or calculated in the usual manner), and the curve of moments of resistance in functions of the number of revolutions.

For convenience the scale of revolutions per minute on the two axes are equal. If now we move a pair of axes $O_1\,x_1\,y_1$ parallel to the co-ordinates, with the origin O_1 on the curve $C\,C$, there will be a point of intersection $O_1 x_1$ with $C'\,C'$ of which the abcissa will be equal to the ordinate of the point of intersection of $O_1\,y_1$ with the curve $n\,n$. This position of the movable axes determines the working condition at potential Δ ; it can be found easily by trial, as the figure shows.

With these diagrams constructed for various values of Δ, we can as usual construct the diagrams of the volts and ampères required for the various velocities; it should be noted that $\frac{\Delta}{r\,d}$ ampères must be added (being the ampères absorbed by the excitation) to those required for the armature.

It will be well to make a few observations on the curve of velocity $n = f\,I$. We can easily see that n is a constant within extensive limits. We have in fact $n = \frac{\Delta - I\,r}{m\,\beta\,Z}$. Now Z varies with I but to a very slight degree; with an increase of I there is only a very slight reduction of the denominator. The product $I\,r$ is small with respect to Δ, and in any case, with a slight increase of I, we have a slight decrease in the numerator. It follows that n is nearly constant, whatever the load may be ; this, however, is better verified with strong exciting currents, as by reason of the powerful magnetic field the re-action of the armature is unimportant. Therefore, by changing p, or modifying the propeller, the number of revolutions will be still maintained, and may absorb too much current, if, for example, too large a screw be fitted to the shaft, and too little work may be developed if too small a screw be fitted. The shunt motor is, in fact, not adapted like the series motor for automatic compensation for any variation of the value p from that designed for it. For this reason, for a shunt motor, particularly with small resistance and small re-action of armature, fixed brushes, and very intense field, we may hold that the diagram of the volts in functions of the revolutions is almost independent of p; at the various differences of potential the motor moment will be always sensibly proportional to I. We may also add that in lowering the potential at the brushes, the revolutions are not reduced proportionately, so that it is most difficult to regulate the speed of a shunt motor in this way within large limits of variation. For example, in the Edison motor, type O_4, which are largely employed in the Royal Navy, whilst the current in the armature increases from 8 to 36 ampères, at 65 volts the speed is reduced from 1,260 to 1,200 revolutions, at 50 volts from 1,100 to 1,025 revolutions, at 40 volts from 1,050 to 900 revolutions, and at 25 volts from 975 to 815 revolutions. These figures illustrate what has been said on the constancy of the speed relatively to

the variations of load and potential. For the various reasons given, the shunt motor is, therefore, never to be preferred to the series for electric propulsion; with a motor having the magnet coils of fine wire, a separate and constant excitation would be used.

With either system of excitation independently of the possibility of varying the conditions of working by commutations in the battery, we must be able to regulate the speed by varying the potential at the brushes by a suitable resistance. The calculation of this resistance is very simple when we know the volts and ampères required by the motor for the reduced velocity we wish to obtain, and is $\frac{\Delta - \Delta'}{I'}$ ohms when Δ is the normal potential at the brushes, $\triangle'$ that required at which the motor absorbs I' ampères, and which current the resistance must be able to support. With the series motor this resistance will be in the circuit, with the shunt motor on the armature only. Under these conditions the number of volts and ampères found by the diagram as necessary for a certain number of revolutions requires correction. It is established that for every required speed the volts at the brushes, and the current in the armature are to be varied; but if the rheostat is inserted in the armature the excitation will remain constant, and the motor, although in shunt, must be considered as if separately excited for the calculation of the rheostat. There is no necessity, however, to make other trials; the diagram already constructed will do to calculate the rheostat with sufficient exactness. From it we know that for n revolutions we require $\triangle$ volts and I ampères, and with $\triangle'$ volts we have n' revolutions, and absorb I' ampères. We may hold that the magnetic field will depend solely on the difference of potential at the brushes, which is approximately true; the values ϵ ϵ' corresponding to $\triangle$ $\triangle'$ are known. Now since at n revolutions the resisting moment will be a certain determined value, if with field proportional to ϵ' a certain number I' ampères are required, with field proportional to ϵ another number I_1' are required, and $\epsilon\, I_1'$ must be $= \epsilon'\, I'$, whence $I_1' = I' \frac{\epsilon'}{\epsilon}$.

We, therefore, have as the value of the current at reduced velocity, that obtained from the diagram multiplied by the relation $\frac{\epsilon'}{\epsilon}$ of the values of the field with excitation complete, or with excitation reduced, which according to the diagram would correspond to the speed reduced. The value of the resistance of the rheostat will then be calculated in the usual manner to absorb $\triangle - \triangle'$ volts with I_1' ampères.

In the case of our Oerlikon motor, referring to the diagram Fig. 2, let us calculate the resistance necessary to reduce the velocity to 400, 300, 200, and 100 revolutions maintaining the whole battery in series consisting, we will suppose, of 80 elements $= \triangle = 150$ volts. We can form the following table without difficulty:—

Revolutions.	Δ'	$\Delta - \Delta'$	I'	$\zeta = \frac{\Delta - \Delta'}{I'}$
450	127	23	35	·66
400	107·5	42·5	30·2	1·41
350	88	62	25·9	2·49
300	67	83	22	3·77
250	50	100	18·5	5·40
200	35·4	114·6	15	7·65
150	23	127	11·8	10·78
100	13	137	8·8	15·58

If we wish then that the motor may work at all the above speeds (in general three or four speeds are sufficient) we must arrange a rheostat composed of a series of eight resistances in our case, the first ·66 ohms, the sum of the first two 1·41 ohms, the first three 2·49, and so on to a total sum of 15·58 ohms.

The first resistance ·66 ohm, suitable for a current of 35 ampères.
1·41 —·66 = ·75 „ „ „ 30 „
2·491—·41 = 1·08 „ „ „ 22 „ etc., etc.

With regard to the elevation of temperature in the rheostat, we may observe that a high temperature may be permitted if it is not a cause of annoyance or a source of danger, which is easily met by a proper mounting with incombustible material.

Motors are often provided with regulating resistances by the makers, when it may be useful to calculate, as above, to find at what speed the motor will work on introducing its own rheostat into the circuit. We construct a diagram of the calculated resistances in functions of the number of revolutions (Fig. 4), and we see at once what speed the motor will assume with any resistance. In our case, to which Fig. 4 corresponds, the resistance accompanying the motor has a maximum of 8·2 ohms, and the minimum number of revolutions will therefore be 170 (always supposing a battery of 150 volts).

If, from a seafaring point of view, the rheostat serves for regulating the speed of the boat when manœuvring, it has an almost more important function from the electrical standpoint: that of protecting the armature of the motor when starting. It is evident that in closing a battery of accumulators on a circuit of very small resistance without any counter electromotive force, as is the case with the armature of an electric motor when stopped and the field not excited, we shall have a very strong current in the circuit, which might burn the insulation. In series motors the coils in series somewhat protect the armature; the strong current which rapidly traverses the magnet coils establishes a very strong moment which favours the rapid acceleration of movement of the armature, and the generation of a high counter electromotive force, so that the strained conditions last for a few moments only. In the case of

our Oerlikon motor with 150 volts at the poles the current which would flow through it would be $\frac{150}{\cdot 5} = 300$ ampères which would injure it in the short period for which it lasts. For this reason the speed regulator should be so fitted that it is not possible to suddenly cut out the whole of the resistances, for even if the motor could support for a few instants the maximum current which would traverse it when at rest, it is necessary to provide for the case of its failing to start at all, and which would certainly result in its being injured; besides which the battery also would almost certainly be ruined. In shunt motors the resistance is still more necessary, because if there were no rheostat on the armature the current would all pass through it, which would be nearly a short circuit on the magnet coils, the magnetic field would not be established, the armature would not start, or commence to move very slowly, thus giving ample time for the insulation to be destroyed.

Connected with the speed regulator, or separate from it but disposed in such a way that it cannot be worked without all the resistances being included, should be placed the commutator for changing the direction of movement. In general this is effected by simply reversing the current at the brushes, which are set in a fixed position suitable for both directions of motion, so that there is no necessity to touch them; the old method of reversing the movement by changing the brushes has been abandoned in modern motors, in which carbon brushes normal to the collector are used. There is no danger in reversing the motion when under way, provided that there is a certain resistance remaining to protect the armature; it is useless to arrest the motor suddenly by putting the armature on short circuit; this is another reason for not employing the shunt motor which lends itself admirably for sudden stoppage by short-circuiting the armature while the magnets are fully excited. It is not necessary to bring the motor up powerfully in this way, the object being to stop the boat quickly, not the motor; now, we get very little effect in this direction by holding the screw fast to stop the way of the boat, the case being different from that of electric cars on shore, in which, by holding the motor fast, which is rigidly attached to the wheels, the power is directly applied in opposition to the motion of the car. The above manœuvre is unnecessary also, because the velocity of rotation of the motor may be suddenly changed by means of the regulator so as to pass without inconvenience from full speed ahead to slow astern, and, after a few moments, almost directly the motor is reversed in direction, to full speed astern. Let us consider, for example, our Oerlikon motor suddenly reversed; whilst working, in a sense, under rather forced conditions with 150 volts, 40 ampères, and 500 revolutions (or counter E.M.F. of 130 volts), and the current in the brushes, including the motor rheostat of 8·2 ohms; the resistance of the motor being ·5 ohm, we have a total resistance of 8·7 ohms. With the current reversed in the armature up to the point at which the movement is reversed, we add the electromotive force of the battery to that of the armature, and supposing the latter maintains its value of 130 volts, which, in practice, would represent the most unfavour-

able conditions, we shall have in the circuit the E.M.F. of $150+130=280$ volts and a current of $\frac{280}{8 \cdot 7} = 32 \cdot 6$ ampères as a maximum. In reality, the E.M.F. of the armature would be much less than this, because the revolutions would be promptly reduced to zero, and the value of ϵ would also decrease. When the armature stopped, the current would have the value of $\frac{150}{8 \cdot 7} = 17 \cdot 25$ ampères, but this current would continue to decrease as the movement of the motor is reversed until it reached a speed of about 170 revolutions (about 12 ampères).

If the magnetic field of the motor is sensibly saturated, as it ought to be, even a considerable increase of the exciting current could not cause much rise of E.M.F. in the armature if there is no increase of speed; it will, therefore, always be the sum of the E.M.F. of the battery and that in the armature, or we may also say double the E.M.F. of the battery, which will never be exceeded in the circuit, and which at the most will last for a few moments only. As we may for a few instants pass double the normal current through the motor we can deduce the rule that we can pass from full power ahead to full power astern directly, by arranging that the circuit presents a resistance about equal to the normal potential divided by the normal intensity. In our case 4 ohms or 3·5 ohms in the rheostat would be sufficient. The armature coming to rest in such a brief interval of time the current soon takes up its normal value, the reverse movement commences and again sets up a counter E.M.F. We can, therefore, quickly cut the rheostat also out of the circuit, putting the motor at full power astern. This advantageous manœuvre is possible because the movement of the screw is independent of that of the ship, but it would not be possible to use it in the case of electric traction on shore, in which the primitive movement of the motor would be maintained by the momentum of the train or carriage; the E.M.F. would be doubled for a more or less extended period of time, the motor acting as a dynamo until the carriage is brought to rest. Also, as the motor is directly applied to the screw shaft by an electric coupling, the shock on reversing the motion is very slight; whilst in tram motors the strains on all the organs of transmission from the motor to the wheels are neither slight nor of short duration.

In carrying out the project for an electric launch we should, therefore, seek to reduce to a minimum the number of different permanent rates of speed, and also the number of variations in speed which we wish to obtain by the rheostat; we should use motors in series with non-commutable coils, and possibly a reverser connected with the speed regulator, so as to have one manœuvring lever only. A conductor will lead from the battery commutator, where the principal terminal screws for taking the current are placed, through a common double pole interruptor and fusible cut-outs to one end of the series coils of the motor, the other end of which is connected by a convenient terminal screw to the speed regulator; from the latter two conductors lead to the

brushes by two securing screws, another screw connecting the return wire to the battery. There are, therefore, only five leads of wires to arrange and ten terminal screws to set up. The conductors should be protected as far as possible, and may also be enclosed in lead. . . . .

As regards the choice of motor from a constructive point of view: I have supposed the motor to be applied directly to the screw shaft without any reduction of velocity, as is the general practice. There is, in fact, no reason for introducing gearing for the transmission when a speed of some hundreds of revolutions per minute are required. Gearing can only be of any advantage in the case of small boats with small motors, when to ensure a high output with a motor of some fraction of a H.P., it is indispensable to work it at some 2,000 or 3,000 revolutions, and it becomes necessary to reduce the speed of the screw shaft to 800 or 1,000 revolutions; in such cases the gearing works in oil, or Gall's chains are employed. Without excessive weight of motor, when directly applied an efficiency of 85% at 400 to 500 revolutions in the larger motors is easily obtained, so that little would be gained in efficiency by gearing when the loss by extra friction is taken into account. As regards the accumulators, those generally used consist, as is well known, of lead electrodes immersed in dilute sulphuric acid of 1·175 density, or about 1 part acid at 66° to 5 of water. Wood, iron, copper and bronze are strongly attacked by this liquid, and if the risk of leakage is not perfectly guarded against, great inconvenience and damage may ensue in the rapid destruction of the battery from defective insulations and destruction of the hull by corrosion. This defect was not the least of the causes which resulted in the ruin of one of our electric boats, and in this particular the construction should not only be suitable but perfect. Very high containing vessels for the liquid, although the oscillations may be lessened by gratings of wood, etc., are of very little use, nor even a stratum of oil above the liquid, the movements of the boat being too violent and extensive for such expedients. It is necessary to avoid the risk of water mixing with the liquid at all costs, more especially sea water, and this could always happen if the elements are open, should the nature of the electrolyte render closed elements less indispensable. I say less indispensable, but not less necessary, for even if the electrolyte be kept immovable (for example, by glass fibre, or by using Schorp gelatine), there are always the phenomena of capillary attraction to contend with. The use of vaseline oil for meeting this difficulty cannot but be recommended, but it is not without some danger, in view of its inflammability. As it may be dispensed with in the hermetically-closed accumulators which are generally employed, its use is superfluous, but still we may hold that it can do no damage in good accumulators, in which short circuits are not likely to take place accidentally. Very often in short circuiting a large quantity of gas is developed, and if this gas were also impregnated with a vapour of mineral oil, accidents might easily occur from its great inflammability and explosive power. In any case, therefore, electric launches, more especially those destined to navigate in salt water, should

have hermetically-closed elements, with the exception, of course, of a small opening to allow the gas which is usually generated to escape.

The use of the gelatine electrolyte, of which so much was expected, has not given very successful results, although it has been the subject of many experiments in the Royal Naval Laboratory at San Bartolomeo. Identical elements were filled with the ordinary liquid and with gelatine, and charged and discharged equally a great number of times. In completely discharging the elements the capacity of the gelatine accumulators with equal charge is not much inferior to those with the ordinary liquid; in other words, the difference of output is not great, as will be seen in the following table of the results obtained:—

Charge Ampère hours.	Discharge.			
	Diluted Acid.		Gelatine.	
	Ampère hours.	Output.	Ampère hours.	Output.
16	14·8	·93	14	·88
17·6	16·5	·94	16	·91
31·4	30·4	·96	29·8	·95
36·9	35·1	·95	33·6	·91

The department for the control of torpedoes and electric material has studied the question, with a view of obtaining a type of hermetically-closed element which would be satisfactory, light, compact, safe and economical. The best arrangements which have been met with in those made by the principal firms have been for the most part adopted, at the same time endeavouring to overcome the weak points in their construction. An Epstein element T_9 hermetically sealed, forms the most convenient unit for an electric launch battery. The weight complete of this transformed element is 34 kilogrammes, of which 25 are lead, 5·5 liquid, 5·5 the case, cover fittings, etc. The dimensions are $8\frac{1}{2} \times 10\frac{1}{2}$ inches base, by $13\frac{1}{2}$ inches high; in the latter dimension is included the necessary space for the connections between the various elements. The capacity of this element, as we have already mentioned, is 130 ampère hours with a forced discharge in two hours, but reaches up to 200 ampère hours with a slow discharge in ten hours.

Large elements, besides the objection of weight, have the grave defect of liability to deformation in plates of large area. The experiments in the French Navy with the accumulators of the submarine boat "Gustave Zédé" bear out this contention. After many trials with accumulators of ordinary dimensions, the "Laurent-Cély" was chosen from the various types by the "Société anonyme pour le travail électrique des metaux," and special accumulators of very large size were ordered. From the first trial on board, however, it was proved that the large plates became deformed and gave rise to short circuiting, so that the battery had

to be entirely transformed. Even for extraordinarily powerful batteries, such as those in the French Navy for submarine boats, which comprise accumulators weighing some 125 tons, very large elements are therefore to be avoided; in such cases, various series of small elements may be grouped together in parallel without inconvenience.

It will not be out of place here to compare the two systems of propulsion for small craft. It is not quite fair to compare two boats of equal dimensions, but it is best to do so, provided that we do not pretend for the electric-boat a motor so powerful as that of the steamer, which on the average would not be just. We may say that the engines of the latter would not develop more than the half of the maximum power, whilst an electric-boat until the battery is discharged can move at once, and always at full power. We could not, therefore, afford to despise an electric-boat of the same dimensions as a steam-boat, although it might have a much less powerful motor, for on ordinary service the difference in the effective power developed will not be so great as would appear at first sight. The motor of the steam-boat will be capable of developing a power very much exceeding the mean, but great vigilance and care must be exercised under such conditions, even with the most recent and perfect models.

The "Direction of Torpedoes and Electric Material" has for the torpedo service two small steam-boats by Simpson, Strickland and Co., which are the subject of universal admiration. They are fitted with a small boiler, which a man could easily clasp in his arms, and a diminutive quadruple-expansion engine, the whole weighing, perhaps, less than a ton. No electric-boat could hope to compete with it for lightness and speed within the same dimensions, but an electric motor would necessitate, when under way, still less attention than the steam motor; it would be quite silent in working, and the maximum of cleanliness could be maintained without difficulty. With equal dimensions also the electric-boat has more space available for passengers, and notwithstanding the advance in this direction with tubulous boilers, the electric-boat would be still more prompt in getting under way than the steamer.

As regards the cost for two boats of equal displacement, it would be about the same, as shown below for those constructed by the General Electric Company, compared with a 30-foot White's boat as used in the Royal Navy, costing when complete 14,000 frcs.

Length.	Beam.	Speed.	Range at full speed.	Cost in frcs.
24′ 9″	5′ 0″	4½ knots	22½ knots	6,700
29′ 6″	6′ 0″	6 ,,	36 ,,	11,000
39′ 6″	6′ 6″	6½ ,,	39 ,,	16,000
49′ 6″	7′ 0″	6½ ,,	52 ,,	22,000

The details of the White's boat, which may be interesting, are as follows :—

Weight of hull, complete with fittings - - - - - -	2·2 tons
,, of engines, boiler, water-tanks, complete with water, etc.	2·05 ,,
Maximum power of engines - - - - - -	28-I.H.P.
,, speed - - - - - - - -	7·7 knots
Range at full speed - - - - - - - -	27 ,,
Cost of hull and accessories - - - - - -	7,600 frcs.
,, engines and boiler, etc., complete - - -	6,400 ,,
Total cost - - - - - - - - - -	14,000 ,,

The cost of the motive apparatus of an electric-boat is due to a great extent to the accumulator battery, the cost of the motor is not heavy, but for the same powers varies greatly with the different makers. In a general way the high-speed motors of slight output are the cheapest, as are those not specially constructed for driving electric launches. This is shown by the following data: Goolden and Co. construct the "water-tight" motor, water-tested, with a guaranteed efficiency of 75% at constant speed of 500 revolutions for types of every power. The price of the motor from 3 to 7-H.P. varies from 1,900 to 2,800 frcs. "Immisch" motors, distinguished by their special supports, which permit of a very high speed of rotation, cost 2,300 frcs. for an 8-H.P. motor at 800 revolutions, and 3,300 frcs. for one of the same power at 500 revolutions. This last type, however, with the same intensity of current can be worked normally at 1,200 revolutions, and develop about 20-H.P.

A motor of the "Allgemeine elektrische Gesellschaft," of 5½-E.H.P., at 780 revolutions, with an efficiency of about 75%, costs only 1,500 frcs. The "Oerlikon" motor also costs relatively little, in which, however, the high output is obtained by masses of iron, which makes it heavy for powers developed at slow speed. A motor of this description of 5-H.P. at 450 revolutions, costs 1,700 frcs.; one of 12-H.P. at 360 revolutions, costs 2,700 frcs. As regards the accessories of the motor, speed regulator and reverser rheostat, coupling for motor and screw shafts, etc., are very variable in price, but in any case the whole can be obtained for a few hundred frcs.; and the more they cost, as a rule, the more durable and satisfactory the arrangement of those fittings will be.

The cost of the battery is also very variable, and as a rule it is well to avoid those makers who offer them at a very low price; and also those which are very expensive, unless they afford a sufficient guarantee of durability to compensate for the high first cost. Referring to a battery of 24-kilowatt hours, which would be sufficient for a boat of the dimensions under consideration, according to the type chosen, and the more or less perfect method of seating, we may expend from 5,000 to 12,000 frcs. The latter price specially relating to batteries of a very heavy type, is excessive, whilst the former would almost certainly mean a defective or inaccurate method of mounting, so that we may consider from 80 to 100 frcs. a suitable price for an element of 150

to 180 ampère hours, mounted with good plates and closed in a satisfactory manner. The cost of a battery complete would be on the average 7,000 frcs., and it could be renovated for about 5,000 frcs., taking account of the old material which could be utilised. This renovation of the battery would be necessary after a not very extended period, and means a large outlay; this is the only reason that the cost of electric propulsion is so high.

We may admit with safety that a good element can stand 300 complete charges and discharges under normal conditions; the capacity will diminish somewhat in time, especially if the preceding discharges have been carried to the extreme, but we shall find that in general a well-kept battery will then still be in fair condition.

Now, if we consider a boat with 26-H.P. hours, for example, 5-H.P. for a little over 5 hours corresponding to each discharge of her battery, we may allow even on active service that not more than about 200 charges per annum would be necessary.

Under these conditions we may fix the minimum duration at 18 months, or an expenditure of 3,600 frcs. per annum, at the maximum 10 frcs. per diem in round numbers, as the cost of renovation of the battery. Against this we may put the cost of the crew in the electric-boat as considerably less than in the case of the steam-boat, the wages for the four men required in the latter amounting to nearly 12 frcs. per diem, whilst the two men necessary in the former could be obtained for about 5 frcs., or a saving of 7 frcs. per day, in the case of the electric motor. As regards the cost of charging the battery as compared with the steam-boat, the cost of electrical energy varies greatly according to circumstances; but with a proper installation for a number of boats, and considering the small staff required, it is improbable that the expense would greatly differ from that of working the steam-boats, and the expenditure in repairs would certainly be less. We may, therefore, assert that it is absurd to condemn the electric system *a priori* for the sole reason that the duration of the battery is an unknown quantity, and it is still more unjust to condemn it on the results of trials made under unsuitable conditions.

There are, however, applications in which economy passes into the line of secondary importance. In the Royal Navy electric propulsion finds, and may find, application more particularly for warlike purposes; and in such cases economy is hardly worth consideration. It will presently be applied in submarine boats, and perhaps in one of White's large boats for carrying torpedoes. As regards the former, we see opinions approach more and more to the idea of a torpedo-boat capable of navigation for a short time completely immersed, so that it is not necessary to use electricity for the ordinary motive power, it being employed only during the short period of actual submarine propulsion. A petroleum motor might well serve for ordinary propulsion, and a boat of a few hundred tons could be fitted with powerful engines, and carry sufficient petroleum for an extended range of action above water. The

electric motors would, perhaps, be well situated between the petroleum engines and the screw shafts, and during the submarine period of action it would be easy to disconnect the petroleum motors, while at other times the armatures of the dynamos could rotate and act as flywheels for them. The difficulty of starting would also be overcome, as the electric motor could be used to assist, and also for going astern under exceptional circumstances, at least until some practical remedy has been found for this defect in the petroleum motor. It would not be difficult to arrange, by proper changes in the circuit, for the motor to act as a dynamo for charging the battery when under way at reduced speed above water.

A solution of this nature, although it may appear complicated, and to carry out practically might present many difficulties, would seem to be preferable to attempting to embark tons and tons of accumulators as has been done in some foreign navies, and up to the present with very little success.

I do not pretend to show that a boat of the nature indicated would have any particular military value, but solely to point out how electricity may be used in the best manner possible as a propelling power for war purposes. It is useless to deny that from this point of view, and from the necessity of using accumulators, electricity has not had up till now an extended field of application in war navies for war purposes; this is not the case, however, for other applications of the power, and the day is certainly not far distant when every operation on board our war-ships will in some way or other be connected with electricity.

Anyhow, the service of electric-boats in peace-time may prove to be convenient, and very little can be found written on the subject, either in the journals devoted to engineering and electricity, or in books occupied with electric motors and accumulators. We find a slight description everywhere, more or less complete, of the more famous boats of the best types which have been constructed; and I have endeavoured to give some logical justification to those principles which we now already see applied with advantage. In doing so, and in bringing under the eyes of your readers a summary of the questions which have to be solved in the study and exercise of electric propulsion, I hope that my labours will not be in vain

Suspension Bridge over the Panjkora River. Chitral Relief Force, 1895.

Constructed of material at hand, viz., forest timber, rope and twisted strands of telegraph wire.

From a Photo by LIEUT. TOTTENHAM, *25th P.I.*

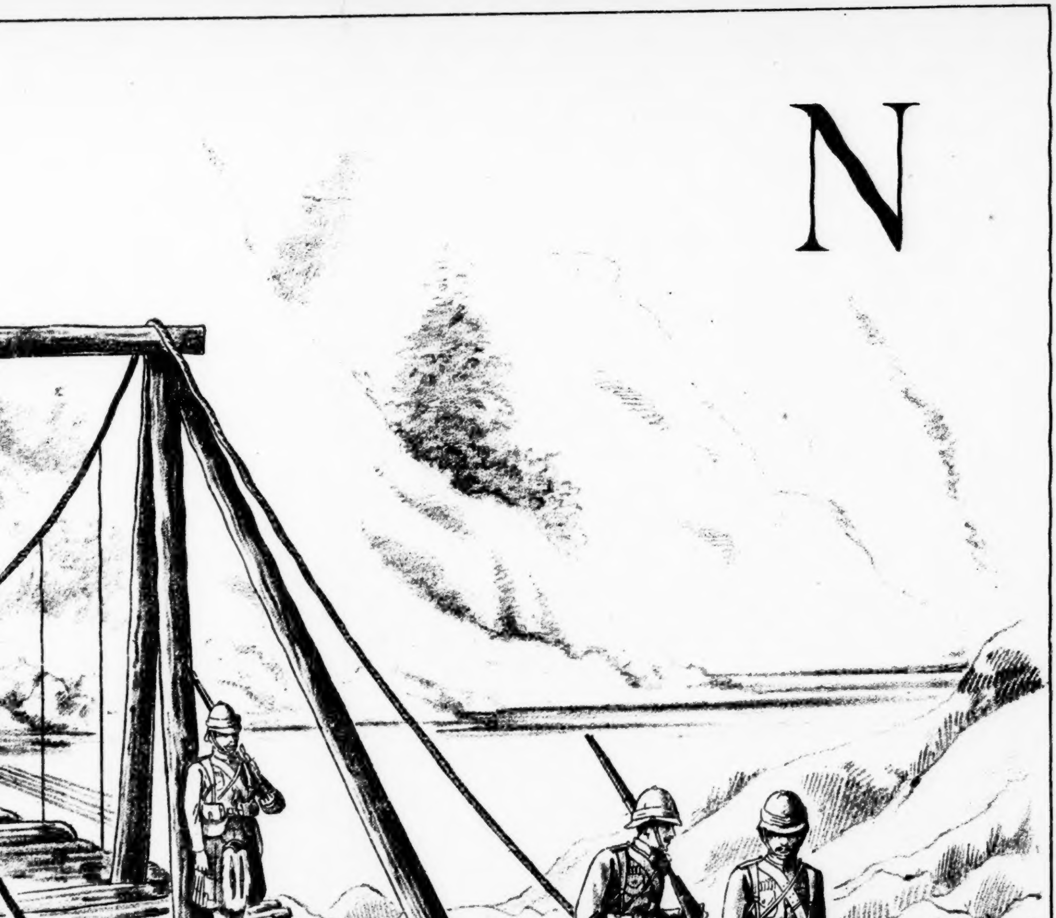
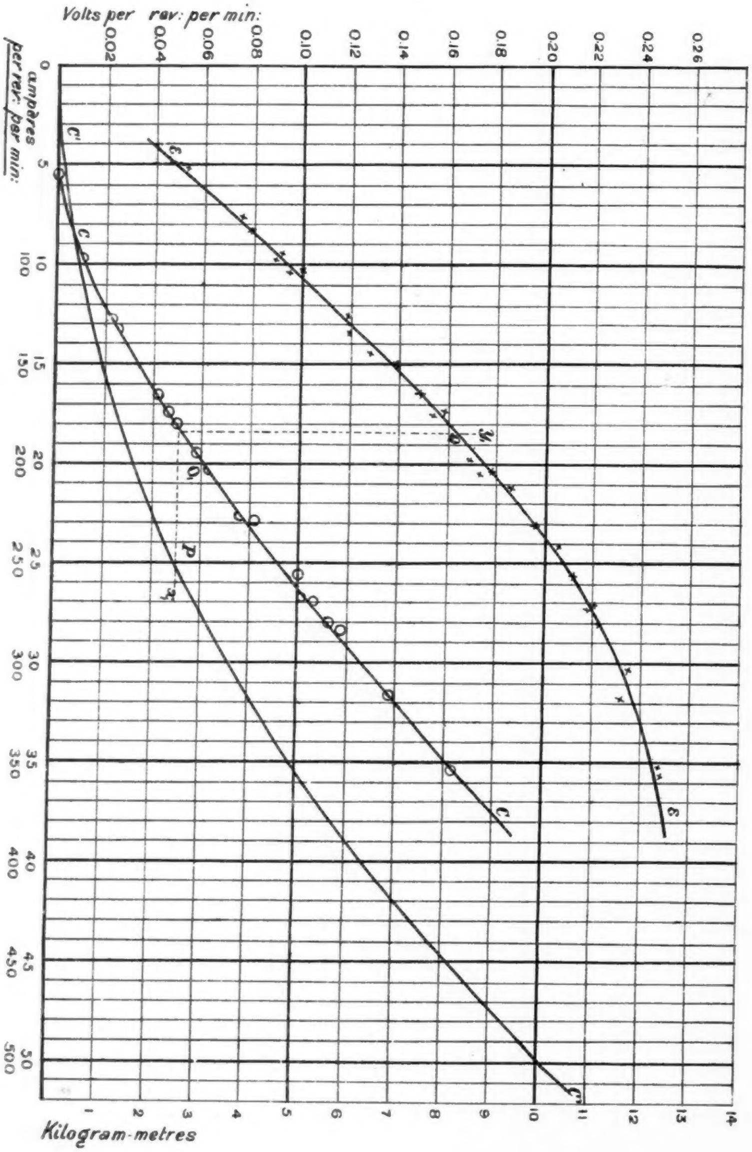
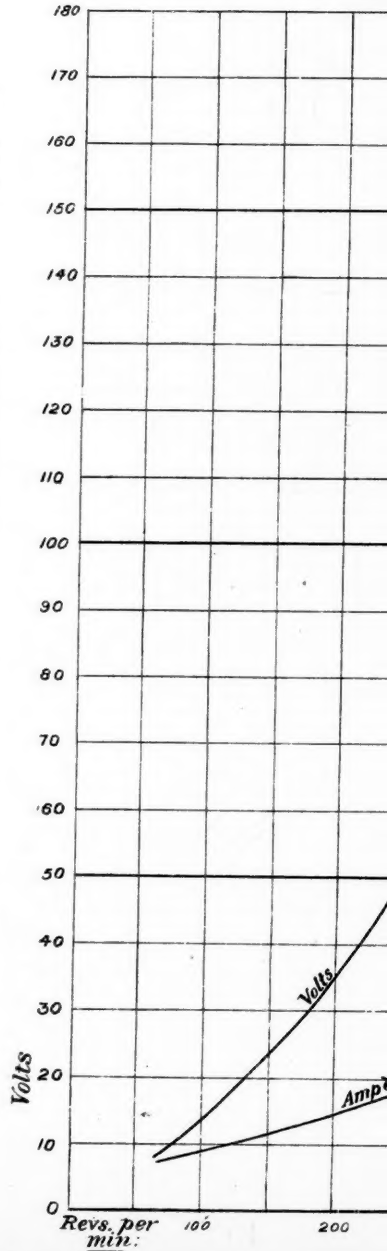


Fig. 1.





J. J. Keliher & Co. Litho. London.

Fig.2.

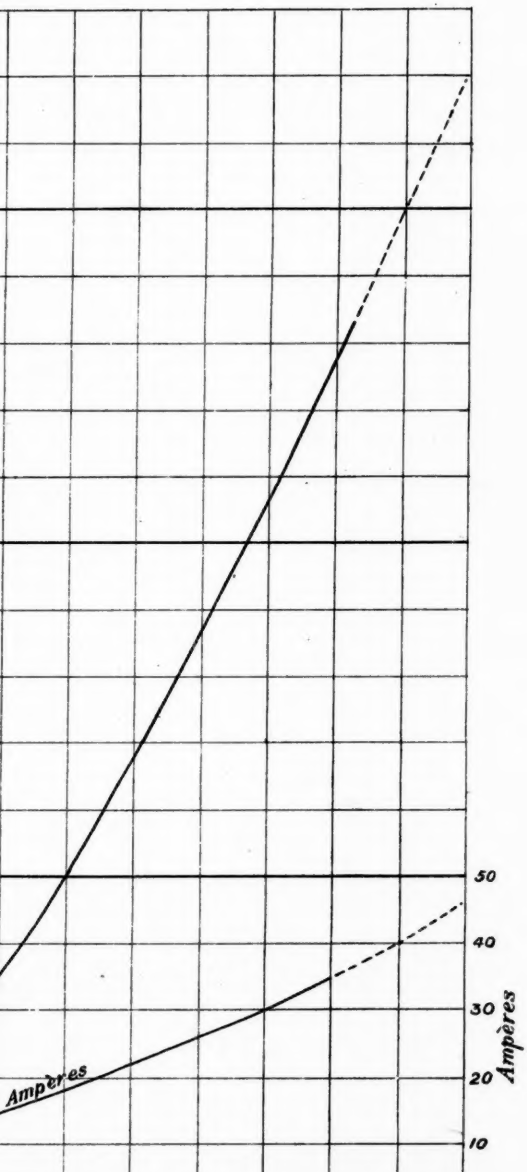
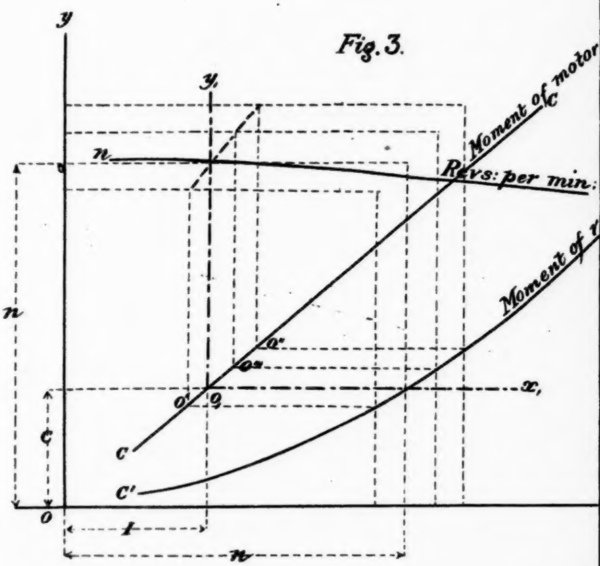

Ampères
Ampères
10
20
30
40
50
00
300
400
500

Fig.3.


y
y,
n
n
Moment of motor C
Revs: per min.
Moment of r
o"
o'
q
x,
C
c
c'
o
1
n


50
40
30
20
10
Ampères

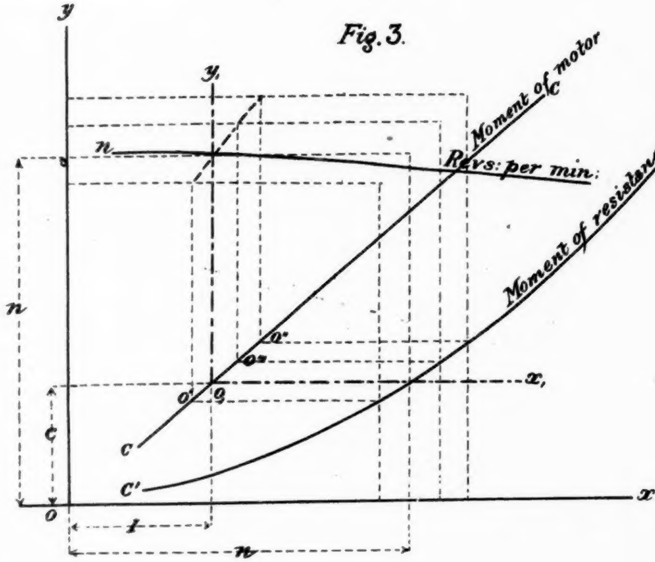

y
y,
n
Moment of motor C
Revs: per min.
Moment of resistance C'
n
o'
o''
x,
c
c
C'
o
I
n
x

Fig. 3.

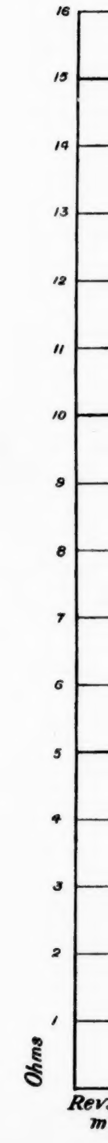
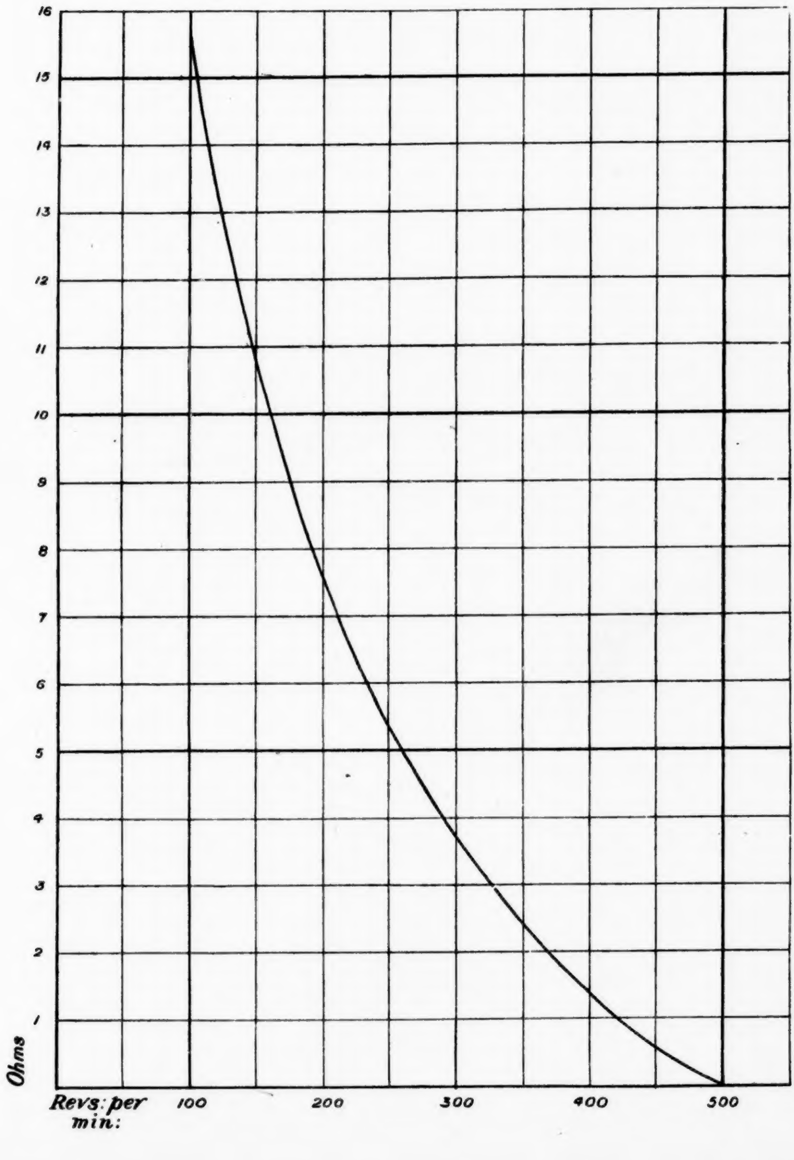

16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Ohms

Fig. 4


16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Ohms
Revs: per min:
100
200
300
400
500

NAVAL AND MILITARY NOTES.

NAVAL.

HOME.—The following are the principal appointments which have been made: Captains—C. C. Drury to "Hood"; R. F. O. Foote to "Forte"; H. D. Barry to "Astræa"; E. Chichester to "Immortalité"; H. B. Lang to "Narcissus"; Hon. M. Bourke to "Cordelia"; J. H. Burke to Inspector of Warlike Stores; C. G. Dicken as Assistant Director of Naval Intelligence. Commanders—A. Galloway to "Daphne"; C. R. Wood to "Medusa"; R. H. Archer to "Eagle"; C. J. Baker to "Sphinx"; H. F. Hay to "Medea."

The first class cruiser "Grafton" has returned to England with the paid-off crew of the "Camperdown," and leaves again for China with new crews for the "Daphne," "Alacrity," "Plover," "Redpole," and "Pigmy." The first class armoured-cruiser "Immortalité" is to relieve the second class cruiser "Mercury" on the China station, and her sister-ship the "Narcissus" proceeds to the same station; the new second class cruisers "Forte" and "Astræa" go to the Mediterranean, thus filling up the vacancies in the squadron caused by the dispatch of the "Edgar" and "Æolus" to reinforce the China Squadron at the outbreak of the Chino-Japanese War. The third class cruiser "Cordelia" relieves the "Cleopatra" on the North-American station, where Captain Bourke will take over the duties of second class Commodore in command of the Fishery Squadron during the fishing season. The "Comus" has left England to relieve the "Hyacinth" in the Pacific. The second class cruiser "Leander" has arrived at Chatham from China, having been relieved by the "Pique," and is to be paid off at that port. The second class cruiser "Sappho," having returned with the paid-off crews of the "Scout" and "Melita," is to leave again for the Cape with a new crew for the "Phœbe."

An important step has been taken by the Admiralty with regard to the training of the Royal Naval Reserve. The third class cruisers "Medea" and "Medusa" have been commissioned, and will take the place of the old wooden frigates "Trincomalee" and "Castor," at Southampton and North Shields respectively, which have served as drill ships up to the present. Neither the "Medea" nor "Medusa" have been commissioned as yet, but although too short ever to maintain the speed of 19 knots, for which they were built, they are useful little vessels, and good for 16 knots, a speed often maintained by the "Melpomene," a sister-ship, when in commission on the Pacific station; they will also add to the number of vessels round the coast in partial commission, but ready for immediate mobilisation in the event of an emergency.

The "Starfish," one of three torpedo-boat destroyers built and engined by the Naval Construction and Armaments Company, of Barrow, completed her official trials last month. She is 190 feet long, 19 feet wide, and has a draught of 5 feet 7 inches, which gives a displacement of 252 tons with 30 tons of coal, stores, etc., on board, the latter being the contract weight on trial for these vessels. The contract speed for boats with water-tube boilers is 27 knots. Her engines are of the triple-expansion type, having three cylinders, 18 inches, 27 inches, and 42 inches in diameter respectively, the stroke being 18 inches. The boilers, four in number, are of the water-tube type, designed by Mr. Blechynden, the engine-works manager to the contractors. The weather was not favourable for quick steaming, there having been rather a rough sea on the Clyde estuary, where the trial was made. The mean speed on the six runs on the measured mile was 27·87 knots,

but this was exceeded on the remaining part of the three hours' runs, as the speed then reached 28·05 knots. The mean speed on the whole run, however, was 27·97 knots. The mean revolutions were 407 per minute, and the mean I.H.P. 4,510. The consumption trial to test the economy at easy steaming was also made, when the weather was still boisterous, the wind blowing with a force of from seven to eight and producing a rough, choppy sea. The fuel consumption trial for these vessels is of twelve hours' duration. The economical speed was fixed at 13 knots, and it was found, by means of a trial on the measured mile, that with 169·56 revolutions per minute the speed of the vessel was 13·278 knots. The mean speed on the whole twelve hours' run was 13·03 knots, the mean revolutions being 166·37 per minute. The I.H.P. averaged 400·4, and the coal consumed during the twelve hours was 8,906 lbs. The consumption, therefore, worked out 39·32 knots steamed per ton of coal burnt.

The "Majestic," first class battle-ship, has completed her trials by finishing her thirty-hours' coal consumption trial. The ship, after being swung for the adjustment of compasses, started on the trial, and in the thirty hours travelled a distance of 440 miles, the limits of the run being the Eddystone and Beachy Head. At the commencement she had a vacuum of 29 inches, but in order to bring down the H.P. to 6,000, or half her forced draught-power, as stipulated by the Admiralty, the vacuum was reduced to 27½ inches. The mean of the thirty hours' run gave 6,075-I.H.P., with 135 lbs. of steam in the boilers, and 85 revolutions, and the coal consumption averaged 1·84 lb. per I.H.P. per hour. After being set in the first hour, the engines worked so smoothly that it was not necessary to touch them again, and the boilers produced the requisite quantity of steam with the greatest ease. The draught was obtained from natural ventilation only, the stokeholds being open, and the forced draught fans were not required.

The new first class battle-ship "Victorious" was launched on October 19th, Mrs. Goschen performing the christening ceremony. The ship is one of the seven sisters of the "Majestic" and "Magnificent," and as full particulars of these ships have already been given, a brief description of the principal details, as given in the *Times*, will suffice.

The "Victorious," whose first keel-plate was laid on May 28th, 1894, is 390 feet long between perpendiculars, has an extreme breadth of 75 feet, and a mean water draught of 27 feet 6 inches, at which her displacement to the load water-line will be about 15,000 tons, this draught giving her a freeboard of 25 feet forward, 18 feet amidships, and 18 feet 6 inches aft. The side protection extends for 216 feet of the middle of her length, and from 5 feet 6 inches below the normal water-line to 9 feet 6 inches above it, the armour-plating being of Harveyized steel, 9 inches thick. At both ends of the armour belt, rounded armour bulk-heads are fitted of the same material, 14 inches, 12 inches, and 9 inches thick. The barbettes at the forward and after ends of the battery are pear-shaped in plan, and are heavily armoured with Harveyized steel, the upper tier of plates being 14 inches thick and the lower, which is behind the side armour, 7 inches thick.

Of the two conning towers, which are circular in form and both of 9 feet 8 inches internal diameter, the forward one is 14 inches thick and the after one 3 inches, both being steel, the former Harveyized and the latter nickel. From the base of each tower a forged steel communication tube, 14 inches internal diameter, descends, the thickness of the forward one being 8 inches and of the after one 3 inches, inside of which are led below the controlling shafts of the steering engines, engine-room telegraph rods, and all the important voice-tubes. The protective deck between the armoured bulkheads is made of two thicknesses of 1½-inch steel plates, with additional 1-inch plates on the sloping sides. Beyond the limits of the side armour the lower deck is protected with two thicknesses of plates of 1½ inch and 1 inch respectively.

The armament of the "Victorious" consists of four breech-loading 12-inch 46-ton guns, protected in a similar manner as in her prototypes, with the exception

that the protecting shields will be modified in form, having mushroom tops instead of flat ones, the shields having 10-inch steel fronts, 6-inch sides, and 4-inch backs, the floor plates being of 2-inch nickel steel, and the roofs of 2-inch plates. Of the twelve 6-inch Q.F. guns, eight are in casemates on the main deck and four are similarly protected on the upper deck. Of the sixteen 12-pounder 12-cwt. guns, eight are placed on the main deck amidships and eight on the main deck fore and aft. Each of the four fighting tops of the ship is armed with three 3-pounder Hotchkiss guns, the shelter deck forward with two 12-pounder boat and field guns, and the boat deck and bridge with eight ·45 Maxim guns. The ship is also fitted with four submerged tubes for 18-inch torpedoes—two on the broadsides forward and two aft—and one stern-tube above water.

The propelling machinery, which has been constructed by Messrs. R. and W. Hawthorn, Leslie and Co., of Newcastle-on-Tyne, consists of two independent sets —in separate engine-rooms—of three cylinder inverted, vertical, triple-expansion engines, the cylinders being 40 inches, 59 inches, and 88 inches diameter, for high, intermediate, and low pressure respectively, all with a piston stroke of 51 inches, the high-pressure cylinders being fitted with piston valves, and the intermediate and low-pressure with double-ported slide valves, all actuated by double eccentrics and double bar link motions, the reversing gear being of the all-round type driven by independent engines.

The cylinders of the main engines are carried at the back by cast-iron columns which form supports for the piston-rod guide-bars, and at the front by turned forged steel columns, the bottom frames forming the bed plates of the engines being of cast steel securely bolted together, and screwed to the frames of the ship. Each set of the main engines drives a four-bladed screw propeller of 17 feet diameter and 19 feet 9 inches pitch (the boss and blades being of Admiralty gun-metal), which, when making 100 revolutions per minute, are each guaranteed to develop 6,000-I.H.P., which, it is estimated, will drive the ship at 17½ knots. A brass surface condenser, having a cooling surface of 6,750 square feet, is provided for each set of engines, the circulating water being supplied by pumps driven by independent engines. The usual auxiliary machinery supplied to the class of ship is fitted in the engine-rooms, surface condensers having 1,800 square feet of cooling surface being provided to receive and condense the exhaust steam.

Steam for the main and auxiliary engines of the ship is supplied by eight single-ended four-furnaced cylindrical tubular boilers, having an aggregate heating surface of 25,826 square feet and a grate surface of 821 square feet, and made for a working pressure of 155 lbs. per square inch. The boilers are placed in pairs in four separate water-tight compartments or boiler-rooms, which can be closed in the usual way by air-locks and the boilers worked by forced draught, eight fans for air-forcing being provided, driven by independent engines. The coal-bunker capacity provided amounts to 1,890 tons, 826 tons being carried in the lower bunkers abreast of the machinery, 424 tons in the wings next to the skin of the ship, and 640 tons on the protective (middle) deck at the sides. This amount of fuel will give the vessel a coal endurance of twenty-eight days at 10 knots, due allowance being made (10 to 12 tons a day) for consumption for auxiliary purposes such as electric lighting, distilling, etc.

The "Victorious" is lighted throughout by electricity; three dynamos, each of 600 ampères and 80 volts, being provided, the arrangement at the switch-board being that either of the dynamos can be put on to any or all of the circuits in the ship. Six search lights are provided, one on the platform above the upper fighting top of each mast and two on each bridge. The vessel is steered by an ordinary tiller working in a special slide arrangement, the two steering engines for actuating the gear being in separate water-tight compartments. Either engine can put the rudder from hard over to hard over, or through 70°, in 30 seconds, with the ship going at full speed.

The following interesting account of the gun trials of the "Majestic" is taken from the report supplied to the *Times* by their Portsmouth correspondent :—"I am indebted to Captain Lloyd, of Sir W. G. Armstrong, Mitchell and Company, Newcastle-on-Tyne, to which firm the Admiralty intrusted the responsibility of mounting the 'Majestic's' principal and secondary armament, for the following particulars :—

"The 'Majestic' is the first large ironclad which has been built since the 'Royal Sovereign' class, and yet, with the exception of the Hotchkiss guns, there is not a single gun or mounting on board the 'Majestic' that does not show some marked improvement on those of her immediate predecessors. The 'Majestic' is armed with four 12-inch Woolwich wire guns, in barbettes; twelve 6-inch Elswick Q.F. (wire) guns, four on the upper deck and eight between decks; sixteen 12-pounder Elswick Q.F. guns; and twelve 3-pounder Hotchkiss Q.F. guns, on Elswick recoil mountings. Interest naturally centres on the 12-inch wire guns and their mountings. The guns themselves are of Woolwich design and manufacture, but before their design was approved of, the representatives from the leading firms of gunmakers were called in and asked to criticise. As the design was put into execution it may be presumed that it was considered satisfactory. It embodies a very full development of the wire or riband construction, no less than 102 miles of wire being wound on each gun. The wire is rectangular in section, and it is wound on with an average tension of 40 tons to the square inch. Jackets of steel are put on the gun outside the wire, so that as far as external appearance is concerned they do not differ from an ordinary steel gun. These 12-inch guns possess a melancholy interest from the fact that they were designed at the Arsenal during the time that Commander Younghusband was superintendent of the Gun Factory, but the guns were not completed until after his lamented death. The breech mechanisms of the 12-inch guns have been designed with a special view to rapidity and ease of manipulation. The only fault that can be found with them is that they are somewhat complicated, but, as one man can open the breech in about 6 seconds, even after firing proof charges, a little complication is excusable.

"The method of securing the guns to their cradles—and now we pass from Woolwich to Elswick designs—is quite new. Instead of the broad bands passing over and strapping the gun on their cradles—as in the 'Royal Sovereign' class and previous ships—'thrust rings' are provided to the 12-inch guns which fit into corresponding grooves in the cradles, and thus transmit the longitudinal thrust of recoil. Slots in the rings and keys keep the guns down in their places. The arrangement actually in use for securing the guns to their cradles are thus all below the axis of the guns, and are well protected. There is another new feature about this method of attachment. It will easily be understood that for convenience the breech screws of guns in a turret or gun-house have to work to opposite hands, the breech screw of the right-hand gun hinging on the right-hand side of the gun and the breech screw of the left-hand gun on the left-hand side. At first sight it appears that to effect this the guns themselves would have to be right and left-handed, a system which would cause, and has hitherto caused, a liberal and costly supply of spare guns. But the Elswick plans get over this by arranging that the guns shall be reversible. If it is required to place the right-hand gun in a left-hand position, it is only necessary to turn it upside down. The 'thrust rings' encircle the gun and, therefore, always coincide with the grooves in the cradle, and slots are provided in the rings to meet the requirements of either position. Each gun with its complete mounting is made to balance (when the gun is out in the firing position) upon a pair of trunnions. These trunnions are fitted to the slides and are strong enough to transmit the shock of recoil to the structure of the turn-table, as well as to take the whole weight of the gun and mounting. The object of the balancing is to make it possible to give elevation or depression to the gun by hand and still retain recoil in the line of fire. The guns may be run in or out by

hydraulic pressure. In firing, it is only the motion of running out that is necessary, for the recoil will always bring the guns in; but for cleaning purposes and drill it is convenient at any time to have the power of running them in. Hitherto guns in the Navy worked by hydraulic power have been loaded in the 'run in' position, but the 'Majestic' guns are loaded when run out. Much more room is thus obtained in rear of the guns for the loading operations. In the 'Royal Sovereign' class there is but the one fixed loading position—that is to say, after each round the turntable has to be brought to a certain fixed position and locked there until the operation is over. If one gun only has been fired, the other has to be practically put out of action for about two minutes until the first has been reloaded. In the 'Majestic,' however, in addition to the fixed ammunition hoist, which has been retained with the idea that to load both guns simultaneously it is the quickest system, there is a central or all-round loading hoist for the supply of the powder, and a considerable stock of projectiles stowed in the gun-house provides the other essential. Thus either gun, or both guns, can be loaded in any position, and the loading of one gun does not in any way interfere with the working or firing of the other. To sum up, every operation can be performed by hand, should the hydraulic gear—which is, however, almost completely duplicated—break down. The guns can be loaded simultaneously at a fixed position, or separately at an all-round position, and the time necessary for working the guns has been much reduced. As to the barbettes, the name is somewhat a misnomer, for the guns have a shield or house covering them which can hardly be distinguished from a turret—indeed, the advocates for the two rival systems of barbette and turret seem, in the 'Majestic,' to have agreed to a compromise. The sloping sides and roof of the gun-house offer no surface to a direct hit from a projectile. The plating is 10 inches in front.

"The 6-inch Q.F. guns have often been described. The mountings for these guns are of the pedestal type, a new design from Elswick. The guns are, as usual, in cradles, but the trunnions of the cradles fit into a Y-shaped steel forging, the stem or pivot of which passes down into a forged steel pedestal fixed to the deck. There are thus no rollers or roller-paths, and all the working parts are well raised above the deck. The whole mounting has the appearance of being massive, strong, and simple. The gun cradles are now stamped by hydraulic pressure out of a plate of steel—not cast as heretofore.

"The 'Majestic' is the first battle-ship which has carried the 12-pounder. A battery of these guns exists on each side of the upper deck. The guns and mountings are miniature copies of the 6-inch. The 'Majestic' is also the first battle-ship to which cordite charges have been supplied for all guns. The 'Majestic' had been lying at Spithead since her torpedo trials, and the ship was under way before nine o'clock. When she was well clear of the eastern end of the Isle of Wight the trials were commenced by the testing of the smaller guns. The 3-pounders in the fighting-tops were the first to open fire, and the Maxims and the other 3-pounders followed. Four rounds were then fired from each of the 12-pounders and two rounds from each of the 6-inch guns. In every case the full charge with projectiles was fired at a mark, and the practice was remarkably good. Subsequently six rounds with full charge were fired from one of the 6-inch guns with a view to testing the rapidity of fire from the pedestal mountings. The shooting was wonderfully good. The first three rounds were discharged in 27 seconds and the second three in 23 seconds. There was also some firing against time from one of the 12-pounder guns, six rounds being fired in 23 seconds and another six rounds in 24 seconds.

"The great feature of the trials was the firing from the 12-inch (46-ton) wire guns. By this time the 'Majestic' was well out at sea. Three rounds were fired from each of the two guns in the fore barbette. In the first round a reduced charge was used to make sure that everything was all clear, the guns being horizontal and trained over the starboard beam. A full charge with a full-weight projectile

was used for the second round, the guns being trained, the one 10° before and the other 10° abaft of the starboard beam. The fixed loading position of the automatic breech gear was used for one gun, while for the other the all-round loading position and the hand breech gear were used, so that both systems had a thorough testing. In the third round the two guns were fixed simultaneously. A still more severe test was applied with the guns in the after barbette. Two reduced charges were first fired and then two full charges, the guns being trained over the port beam. The firing was against time, the fixed loading position being used for one gun and the all-round loading position for the other, and the time was taken from the firing of the first round, the assumption being that there would be ample time to load for the first round before the ship entered an action. Here again most satisfactory results were obtained. In the case of loading from the fixed position the interval of firing rounds was 1 minute 19 seconds, and in the case of loading from the all-round position it was 1 minute 21 seconds. This was much better than was guaranteed by Elswick, and it was quite evident that drill would bring about a still greater improvement. In the case of the guns of the 'Royal Sovereign' class the interval of firing rounds was 120 seconds. The fact of their being heavier would make no difference, as hydraulic machinery is but little affected by heavy weights. The guns and the hydraulic gear worked to perfection and with the greatest smoothness. There was not the least hitch anywhere. All the guns were fired with cordite, and from what I can gather the Ordnance officers were very favourably impressed with the new explosive."

BRAZIL.—The following note was by a blunder on the part of the printers placed among the Periodicals last month, it has, therefore, been considered advisable to reprint it:—In addition to the two battle-ships of 3,500 tons which are under construction at the "Forges et Chantiers de la Méditerranée," at La Seyne, the Government are about to construct the following vessels:—Three protected steel cruisers, which are to have their bottoms sheathed with wood and coppered, and will be of 4,000 tons displacement, with a speed of 19 knots under natural and 20 knots under forced draught; the coal supply is to give a steaming radius of 10,000 miles at 10 knots. Three torpedo-cruisers of 1,000 tons displacement to have a speed of 20 and 22 knots under natural and forced draught respectively, with a steaming radius of 3,000 miles at 10 knots; the armament will consist of two 10-centimetre (3·9-inch) Q.F. guns, and six 6-pounder Q.F. guns, with three torpedo-tubes. Eight torpedo-boat destroyers, with a speed of 26 knots, of the "Gustavo Sampaio" type, and six first class torpedo-boats. Finally, two submarine boats of the "Goubet" type have also been ordered; they will be 26 feet long, cigar-shaped, and be constructed of bronze, and are to be capable of remaining under water for 15 hours, oxygen being furnished by reservoirs and the vitiated air being pumped out; they will be driven by electric motors of 2-H.P., giving a speed of 8 knots, and the torpedoes can be detached automatically at any depth.—*Revista Maritima Brazileira.*

FRANCE.—The following are the principal promotions and appointments which have been made: Capitaine de Frégate—M. de Percin to Capitaine de Vaisseau. Capitaine de Vaisseau—Ferrand to Director of Submarine Defences at Cherbourg. Capitaines de Frégate—Baudry-Lacantinerie to "Annamite"; Richard-Foy to "Ibis"; de Surgy to "Linois."

The new first class battle-ship "Brennus" has not yet succeeded in getting through her steam trials at Brest; on the last run under forced draught the trial came to a premature conclusion by the overheating of the heads of the connecting-rods, occasioning a further delay of some three weeks. The torpedo-catcher "Cassini" has also broken down during a full-speed run on the 28th ult., owing to the overheating of the eccentrics, the collars and straps broke, and it will take a month to repair the damage.

The new second class cruiser "Friant" has proceeded from Brest to Bordeaux to have some repairs to her machinery carried out by the Chantiers de la Méditerranée, who had supplied her machinery. After the completion of the repairs to the first class cruiser "Duquesne," she will be grouped in the second category of the reserve with a similar ship, the "Tourville," both vessels being under the command of a Capitaine de Frégate with a single staff for the two ships.

The new third class cruiser "Linois" has been commissioned to take the place of the "Lalande" in the active squadron of the Mediterranean; the "Lalande" will in turn pass into the squadron of the Reserve, relieving the "Forbin," which will be paid off into the second category of the Reserve at Toulon. Contrary to expectation the old armour-clad "Richelieu," which has lately passed into the Reserve at Toulon from being the flag-ship of the Reserve Squadron, instead of being struck off the list of effective ships, is to be supplied with new boilers. The "Richelieu" was launched in 1873, but is only a wooden ship armour-plated.

On the 17th ult., the new first class battle-ship "Charlemagne" was successfully launched at Brest. She has been designed by M. Thibaudier, director of the arsenal at Rochefort, who also drew out the plans for the armoured-cruiser "Charner," and her four sisters. Her length exceeds that of any other French battle-ship yet afloat, and she is built upon finer lines than her predecessors, having 5 feet less beam than the vessels of the "Jaureguiberry" class, which are, at the same time, 29 feet shorter.

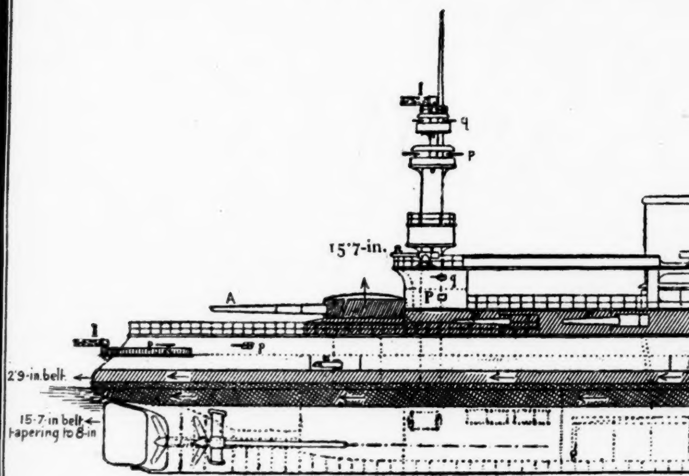
The dimensions are as follows:—Length, 117·5 metres (385 feet 6 inches); beam, 20·5 metres (67 feet 3 inches); depth, 14·87 metres (48 feet 9 inches); draught forward, 7·4 metres (24 feet 3 inches); draught aft, 8·4 metres (27 feet 7 inches); displacement, 11,130 tons (metric, or 10,951 tons of 2,240 lbs.). In these vessels we see a return to the most pronounced form of ram bow, which has always been, until recently, a feature of French steam men-of-war. The free-board is high, about 25½ feet at the bow and 19 feet aft. The forecastle deck is carried aft, the full width of the ship, to a point a few feet forward of the forward turret. From there the upper works, continuing at the same height, become a superstructure above the true upper deck, and this superstructure extends aft with parallel sides to a point a few feet abaft the fore military mast. It is then increased in width by two successive steps, 10 or 15 feet apart, the side between the steps being parallel to the midship fore-and-aft line as before, and the second increase of width carrying the side out to the full beam of the ship. This full width continues aft for 15 or 20 feet, when it is decreased by successive steps like those forward, and, finally, the superstructure sides are swept in at a 45° angle and end in a segmental bulkhead around the forward side of the base of the after turret. Extending completely across the superstructure at each end, and rising 8 or 9 feet above it, are two deck-houses, through which pass the masts. Resting on top of these deck-houses, and extending between them, is a strong flying deck. Each mast has two military tops, covered with light shields, in which are mounted small Q.F. guns. On top of the covering shield of the upper top, which shield forms a platform for it, is mounted a search light. Below the lower top on each mast there is a roomy, circular, lightly-armoured observation tower. In the forward one, which is a few feet higher than the other, are voice-tubes, indicators, etc., for the use of the admiral or captain. The one on the aftermast is fitted for the use of the torpedo officer. The conning tower proper is situated on the flying deck over the forward deck-house. The voice-tubes from these three towers lead to a central station below, where they may be connected up to others extending to the various parts of the ship.

The protection to the hull proper consists of a water-line belt of thick armour extending from stem to stern. Its average width is 2 metres (6 feet 7 inches)—0·5 metre (20 inches) above the load water line and 1·5 metres (4 feet 11 inches) below. The maximum thickness amidships is 40 centimetres (15·75 inches).

This thickness is carried from the upper edge to 0·2 metre (8 inches) below the load water line; from that point the thickness decreases to 25 centimetres (9·84 inches) at the lower edge. Above this a light belt, 75 millimetres (2·95 inches) thick and 1 metre (3 feet 3·9 inches) wide, extends forward from the stern, about two-thirds the length, to a point a little abaft the foremast. From this point this thin belt extends up—about double its previous width—to the under side of the main deck, and is continued forward over the ram. Around the stern, from the top of the light armour to the under side of the deck above, the side plating has a thickness of 20 millimetres (0.79 inch). Behind the light armour belt, resting on the thick armour deck, and extending completely around the ship, is a coffer dam 1 metre (3 feet 3·9 inches) in height. There are two armour decks: one, covering the top of the thick armour belt from stem to stern, is 9 centimetres (3·54 inches) thick; the other, also complete, is at the level of the lower edge of the belt, and is 4 centimetres (1·57 inch) thick. This latter deck is but a development of the splinter deck which has been fitted over the boilers and engines in nearly all recent French ships. All of the machinery and vitals of the ship are below the lower armour deck. The space enclosed between the decks is closely subdivided. The protection to the battery is given below.

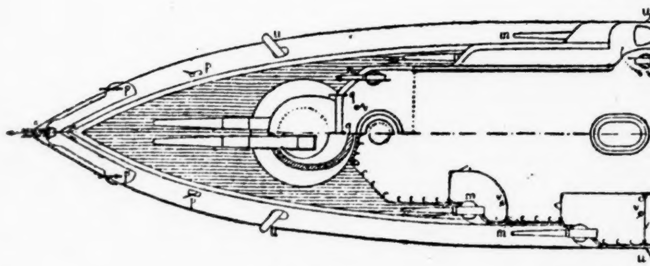
The main battery consists of four 30-centimetre (11·81-inch) guns, mounted in pairs in turrets on the midship line--one forward, one aft. These turrets are 40 centimetres (15·75 inches) thick, oval in plan, and eccentrically pivoted to balance the weight of the guns. The forward guns are 8·5 metres (27 feet 11 inches) above the water-line and the after ones 6·5 metres (21 feet 3 inches). The auxiliary battery consists of ten 14-centimetre (5·5-inch) Q.F. guns and six 10-centimetre (3·91-inch) Q.F. guns. Eight 14-centimetre guns are mounted in the superstructure, four each side, in the angles formed by the successive cutting away of the superstructure forward and aft from amidships, where it extends the full width of the ship at the upper deck. This arrangement allows four to be fired ahead, or on each bow or beam. Two 14-centimetre guns are mounted on the superstructure, one each side amidships. The 14-centimetre guns are protected by side-plating, 7·5 centimetres (2·95 inches) thick, and by shields on the guns. The battery in the superstructure is further protected against raking fire from forward by a thwartship bulkhead, also 7·5 centimetres thick, placed just forward of the forward pair of guns; and they are also shielded against fragments of bursting shells, etc., by splinter bulkheads and partitions worked round each gun. The 10-centimetre guns are all mounted on the flying-deck, one on each side, near the forward and after ends, and one on each side amidships. They are unprotected either by plating or shields. Ready supply of ammunition to all the guns is provided by ammunition-hoists and tubes discharging close to the breech of each gun. The secondary battery consists of sixteen 3-pounder Q.F. guns and eighteen 1-pounders (some accounts say ten 1-pounders and eight 37-millimetre revolving cannon). Eight 3-pounders are mounted on the main deck, four each side. The after pair are in sponsons and have stern fire. They are the only ones which can be trained parallel to the line of the keel. The other eight are mounted in the middle tops. Three 1-pounders are mounted at each end of the flying bridge, one in each side of each of the deck-houses supporting the flying-deck, and the remaining eight in the upper tops. There are four submerged torpedo-tubes, two forward, two aft; and six above-water tubes, one on each bow and quarter and one on each side amidships. Abreast each above-water tube, for a few feet forward and abaft the torpedo-port, the armour of the upper belt is carried up to the deck above, thus affording protection against high explosive shell and the projectiles of small rapid-fire guns.

Three screws are fitted. The shafts all lie in the same horizontal plane, and the engines—four cylinder, triple-expansion—are placed abreast each other in three water-tight compartments. Steam is furnished by twenty Belleville boilers, of which eighteen are below, arranged in four stoke-holds; the other two, for

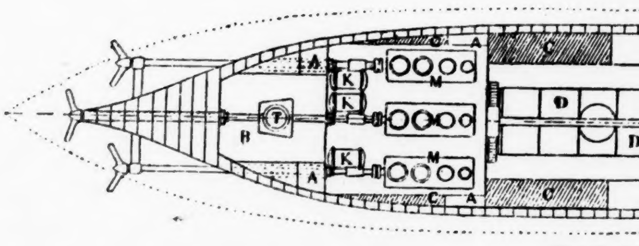


AA—11·8-in. Guns.
F Chart House.
G—Conning Tower.

PP—Directors fo
mm—6-in. Q.F. G
nn—4-in. ,,
II - Sea



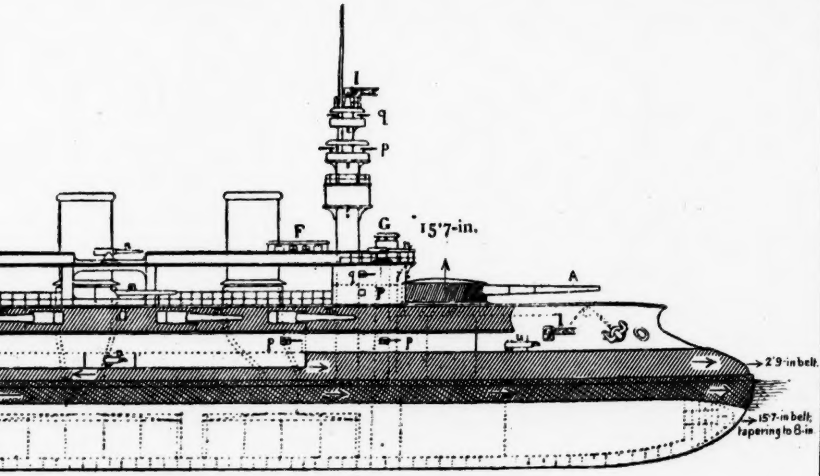
UPPER AND I
vv – Ammun



PLAN OI

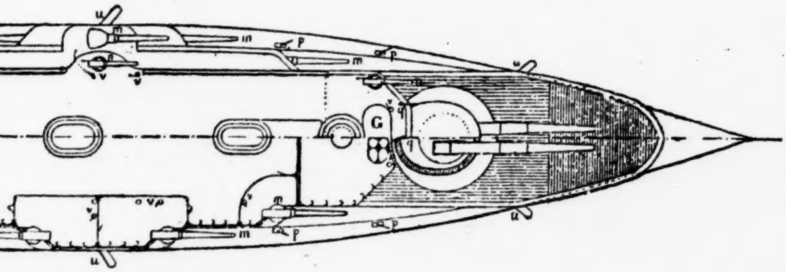
AA—Magazines for 6-in., 4-in., 3-pounder, and 1-
Q.F. Guns.
BB—Magazines and Shell-rooms for 11·8-in. Guns
TT—Pivots for Turrets of 11·8-in. Guns.

Profile and Deck Plans of New French Battle Shi



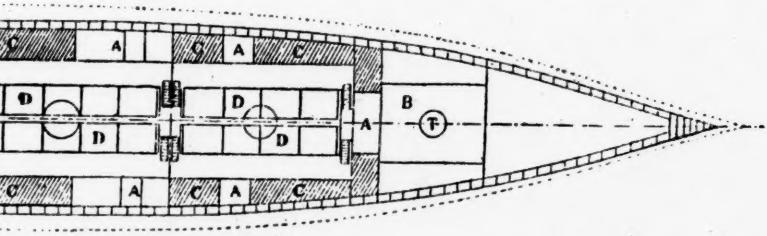
-Directors for Torpedo discharges.
-6-in. Q.F. Guns.
-4-in. ,, ,,
II-Search Lights.

pp—3-pounders.
qq—1-pounders.
uu—Torpedo discharges.



ER AND BATTERY DECKS.

vv-Ammunition Supplies.



PLAN OF HOLDS.

nder, and 1-pounder

1·8-in. Guns.

ns.

CC—Coal Bunkers.
DD—Boilers.
MM—Engines.
KK—Condensers.

Battle Ship "CHARLEMAGNE." Scale 0·0016 = 1 ft. 3 in.

auxiliary purposes, are placed on the armour-deck. The engines are to develop 14,000-I.H.P., and the expected speeds are 18 knots with forced draught and 17 knots with natural draught. The coal supply at load draught is 680 tons, and the total capacity 1,100 tons. It is estimated that 680 tons will give a steaming radius of 4,000 miles at 10 knots, but this is hardly likely—3,000 will probably be found to be nearer.

NORWAY AND SWEDEN. — The Norwegian Parliament having voted the necessary credits, the Government is about to have built by contract two small armour-clads and three sea-going torpedo-boats. The dimensions of the armour-clads will be as follows :—Length, 270 feet 6 inches ; beam, 47 feet ; draught of water, 15 feet 3 inches, with a displacement of 3,400 tons. The engines are to develop 3,700-I.H.P. under natural draught, giving a speed of 15 knots, to be increased to 16 knots under forced draught. The armament will consist of two 25-centimetre (10-inch) guns in barbette turrets, one forward and one aft ; four 5-inch Q.F. guns and sixteen Q.F. guns of small calibre.

The four old turret monitors, "Mjolner," "Skorpionen," "Thor," and "Thrudvang," are to receive a modern armament, and to undergo a thorough repair.

The Swedish Government proposes to submit to Parliament in the coming session a new programme, which will give the fleet fifteen small battle-ships, thirty first and second class torpedo-boats, and six torpedo-boat catchers, instead of the three armour-clads and sixteen torpedo-boats which form the fleet at present. It is not, however, considered probable that the Chamber will vote the necessary credit.—*Le Yacht.*

The question having been raised whether pigeons could be relied on to carry messages during the course of a naval engagement, the experiment was tried at the last manœuvres. It was found that the birds became so stupefied by the noise of the firing, that they refused to leave the ship when released.

UNITED STATES.—The "New York," which forms the frontispiece this month, has already been so fully described that it will only be necessary to recall her leading characteristics. She is a belted cruiser of 8,500 tons displacement and 16,500-I.H.P., with a speed of 21 knots. She has a narrow continuous belt of 4 inches on the waterline. Her armament consists of six 8-inch guns, four mounted in pairs in two 10-inch turrets forward and aft, and two others in barbettes similarly armoured on either broadside ; of twelve 4-inch Q.F. guns, six on each broadside, mounted in sponson ports of 4-inch armour, and separated inboard by light traverses ; and of eight 6-pounder and four 1-pounder Q.F. guns, and four machine-guns, two small Q.F. guns being mounted in each of two military tops. There is no armoured protection immediately beneath either turrets or barbettes.

On the 2nd October, the armoured-cruiser "Brooklyn" was launched from Cramp's Yard at Philadelphia. She is an enlarged and improved "New York," being 14 feet longer, and having 1,000 tons more displacement. Her dimensions are :—Length, 400 feet 6 inches ; beam, 64·6 feet ; normal mean draught, 24 feet ; the engines are to develop 16,000-I.H.P., to give a speed under forced draught of 21 knots. There will be a 3-inch steel belt round the waterline, with a protective deck tapering from 6 to 3 inches. The armament will consist of eight 8-inch guns, two in pairs in turrets protected by 8-inch armour, one forward and one aft ; and two on each broadside in armoured barbettes, also protected by 8-inch armour ; twelve 5-inch Q.F. guns in sponsoned ports on the main deck with 4-inch armour shields, and separated by splinter traverses ; twelve 6-pounder Q.F. guns, and four machine-guns, with five torpedo tubes. The total coal capacity will be

1,753 tons, and the normal supply at ordinary draught 900 tons. The steaming radius at full speed will be 1,700 knots, and at 10-knot speed 6,000 knots.—*Scientific American.*

The British Consul in Baltimore states that tests of the aluminium boats recently constructed by a Baltimore firm have been made under the supervision of the United States Naval Department, and are reported to have proved singularly successful. The first boat which was experimented upon was 18 feet long, 4 feet beam, and 2 feet deep amidships, and weighed 350 lbs. It was placed empty in the water, when a man tried unsuccessfully to capsize it by sitting on the gunwale. It was then heavily laded, yet remained 4½ inches above water amidships. The boat was subsequently unloaded and the air-tight compartments tested by capsizing it, yet it was found impossible to get it more than half-full of water, as the air-tight compartments held it so high as to act on the principle of self-bailer. The boat was then taken alongside a wharf and filled with water until the gunwale was flush with the surface, when a man got on each end over the air-tight compartment. Even then the boat did not sink, but so soon as cast loose it heeled over, emptied one-half of the water, and then righted itself. The naval officials are said to have been much impressed by the success of these experiments, and to have reported favourably on them as ship's lifeboats, and for other life-saving purposes. Their great drawback lies in the extreme susceptibility of aluminium to the corrosive action of salt water.

The new armoured-cruiser "Maine" has lately been commissioned, but according to recent telegrams grave defects have been discovered in her. It appears that now she is complete for sea she draws 3 feet more water forward than aft, and also has an ugly list to starboard. She was designed to have a mean draught of 21·5 feet; but she draws 20·5 feet aft and 23·5 feet forward. According to the report, an official enquiry is to be held.

The "Maine" was built at the Brooklyn navy yard, her keel plate being laid on October 11th, 1888, and the launch taking place November 18th, 1890. Her dimensions are:—Water line length, 318 feet; breadth, 57 feet; mean draught, 21 feet 6 inches; and displacement, 6,648 tons. The twin screws are driven by the usual type of vertical, triple-expansion engines, and they develop 9,000-I.H.P. This should give a sustained sea speed of 17 knots an hour. On her trial trip, which was run before her heavy guns were on board, she realised the high speed, for a battle-ship, of 18·37 knots an hour.

In armament and disposition of armour the "Maine" is similar to the Chinese battle-ship "Chen Yuen." The main battery consists of four modern 10-inch guns, mounted in two turrets. The turrets are plated with 8-inch steel, and they revolve within barbettes of 12-inch steel, which serve to protect the hoisting and turning machinery. These barbettes are carried down to the level of the water-line belt of 12-inch steel. This gives an unbroken wall of protection from the guns to the water-line. The turrets are arranged diagonally amidships, and the superstructures are so disposed that all four guns can be fired at once, either ahead, astern, or on either broadside.

The secondary battery includes six 6-inch guns, of which three can be at any one time trained ahead, astern, or on the beam. They are protected with 2-inch shields. There are also eight 6-pounders, eight 1-pounders, and four Gatling guns. The water-line armour belt is 180 feet long and 12 inches thick. The "Maine" carries four torpedo tubes, one ahead, one astern, and one on either broadside.—*Scientific American.*

An interesting experiment was lately carried out at the Indian Head Proving Ground to test an armour-plate structure submitted by a Frenchman named D'Humy. Mr. D'Humy's invention consists of a number of nickel steel Harveyized plates ranging from 1 to 3 inches in thickness, which are placed in a steel box and so arranged that the edges of the plates are presented to the gun firing at it. He

believes that by his plan, in case of war, the Government could get any foundry to turn out the kind of plates his invention calls for, and the ships of the Navy could consequently be quickly supplied with armour. Another advantage he claims for his invention is, that if one of the steel boxes containing the plates were to be struck and destroyed by a projectile while fitted to the side of the ship, the plates could be quickly removed and others substituted without trouble. The backing of the structure was a 36-inch piece of oak, the same supplied to all armour plates fired at at the Proving Ground. As the structure was 6 inches in thickness, a 6-inch gun was used. The projectile was of the Wheeler-Sterling type. It was given a velocity of 2,100 feet per second, and struck the structure near the centre, breaking it up and scattering the thin plates and fragments to distances of at least 30 feet. Much to the surprise of the ordnance experts, the projectile broke up before getting through. It failed to penetrate the oak backing, simply bulging it out 4 inches.—*Army and Navy Journal.*

"An interesting and important trial of a section of the side armour of the battle-ship 'Iowa' was lately held at Indian Head. Depending upon the results was the acceptance or rejection of 631 tons of armour for the belt of the 'Iowa.' The plate was supported by a structure made to represent a section of the ship's side between and including the armour shelf and the protective deck, and running into the vessel as far as the wing passage, behind the armour. No test of the kind had previously been held in this country or abroad, and the experiments gave practical information of value to the ordnance experts and officers of the constructor's corps. The plate, which was made by the Carnegie Steel Company, was 16 feet 1 inch long, 7 feet 6 inches wide, and 14 inches thick at the top. It tapered from a point 4 feet below to 7 inches thick at the bottom. The weight was 27 tons. The plate was secured to a backing consisting of 5 inches of oak and two ⅝-inch skin plates, with sixteen 2·8-inch bolts and ten 2·4-inch bolts. The section representing the ship was cellular. In the rear of the plate a space 2 feet deep was divided by horizontal and vertical bulkheads into sixteen compartments. A space 3 feet deep behind was divided into four compartments. Thus the stress of impact was distributed over a large area of supporting structure. The entire section was firmly bolted to timbers imbedded in the ground, and in the butt behind the plate. Incidentally, advantage was taken of the opportunity to try new armour bolts suggested by the Bureau of Construction and Repair. The bolts are shorter and more simple than those heretofore employed.

"Three shots were fired at the plate. The first was a 10-inch armour-piercing Carpenter shell. It struck 70 inches from the left end of the plate, and about 1 foot above the bevel with a velocity of 1,472 feet. Its energy was 7,521 foot-tons, the blow being the same in severity as would occur with a 10-inch gun fired at a range of 3,900 yards. The shell smashed on the face of the plate, penetrating but 4 inches. The structure was damaged in no respect. The second shot, also a 500-lb. Carpenter, had a velocity of 1,859 feet per second, an energy of 11,993 foot-tons, and a corresponding range of 2,925 yards. The shell penetrated about 10 inches, and was smashed up. The structure showed no change, except about the point of impact, where the skin plate in the rear of the wood was slightly bulged, and an armour bolt directly in rear driven out. Thus the plate successfully passed the acceptance test, and the group of armour which it represents will be accepted. A third shot was then fired with a 12-inch gun, a Wheeler-Sterling shell weighing 850 lbs. being employed. The striking velocity was 1,800 foot-seconds, the energy 19,091 foot-tons. The point of the shell went through the thin plating behind the wood backing. The wood was set on fire by the intense heat. The protective deck above was buckled up slightly, perhaps 2 inches, but no rivets were sheared. The thin plates in a small compartment behind the point of impact were bent and buckled in, but 3 feet further away

there was little evidence of distortion. One bolt was broken. Generally speaking, the trial was highly satisfactory, the plate passing a test as severe as that required for armour 17 inches thick. The bolts proved equal to the emergency.

"A further test of the same armour structure representing a section of the side of the 'Iowa' was made a few days later at Indian Head. At the first trial it successfully withstood shots from a 12-inch gun. On the second occasion it was fired at by a 13-inch gun. The plate was 14 inches thick and of Harveyized nickel steel. A Wheeler-Sterling projectile was used. It weighed 1,100 lbs. It had behind it 480 lbs. of powder. The distance of the gun from the plate was 380 feet, and the projectile had a velocity of 1,800 feet per second. It struck the plate upon that portion not injured by the previous shots, and cracked it into three pieces. The shot went through the plate and backing, and disappeared in the sand. The shot-hole was clean, and the plate was in no sense shattered. In other words, the damage was local. Two frames in the wake of the projectile were destroyed. One was probably carried away by a piece of the plate which was broken off on the inside. The backing plate on the protected deck was not disturbed, and only two armour bolts were displaced. The experts who witnessed the tests said that there was no doubt that the shot would have penetrated any armour made. Ordnance officers attach importance to the trial, and say that it shows the wisdom of adopting 13-inch guns for the new battle-ships, instead of 12-inch guns, the tests proving that a 13-inch projectile would penetrate armour which a 12-inch one could not get through."—*Army and Navy Register.*

MILITARY.

BATTLE OF CHILLIANWALLA.—LETTER FROM GEN. SIR CHARLES GOUGH, V.C., &c.

SIR,—With reference to the statements of General Thompson and Lord Chetwynd in the recent (October) number of this Journal, all I have to say is, that my account of the battles of Chillianwalla and Goojerat, published in the March number, was compiled from the original reports of general and commanding officers still existing among the late Lord Gough's papers; the formation of Pope's cavalry brigade, and all the statements made with reference to it, were taken from the reports made by officers commanding regiments in that brigade, by Brigadier Pope, and by Colonel Bradford, the next senior officer of the brigade, which were written within forty-eight hours of the battle, and are, I am inclined to think, more reliable than those of General Thompson, "to the best of his belief and recollection," after forty-six years.

I made no imputations on regiments, nor would I desire to do so now. I related a most disastrous occurrence, because it was necessary to do so in order to get a right understanding of the chequered events of a battle which has never been properly understood. Had this cavalry brigade been well handled, the Sikh army would have been driven into the river, and Chillianwalla would have been a decisive victory. I hope I may have thrown some light on it, and that lessons may be learnt.

I take this opportunity of correcting a mistake which may be made as to the strength of the army that fought at Chillianwalla. I have not been able to find any returns giving strength of regiments in action. There is a return of the 1st January, 1849, taken at Heylah, which gives the total numerical strength then at about 22,000, but it has always been estimated that the British force in action numbered about 13,000 men. Brigadier Mountain states in his memoirs that his brigade, which was in Gilbert's division, went into action 2,493 strong. He had one European infantry and two Native infantry regiments; the former may then have been about 950 strong, and the latter about 750 each, which was probably, as nearly as possible, the average strength of European and Native regiments. The 24th, an exceptionally strong regiment, took into action 1,000 men. The European cavalry regiments about 400 each, and the Native cavalry 300 each; thus—

Four British infantry regiments at 900 - - - - -	3,600
Ten Native infantry at 700 each - - - - - -	7,000
Three British cavalry at 400 each - - - - - -	1,200
Four Native cavalry at 300 each - - - - - -	1,200
	13,000

The artillery force would be counted by guns; this would give very nearly the actual strength of the force engaged. It may have been thought, from my having given the larger number that was shown by the annual return of the 1st January, that the same number went into action at Chillianwalla. I should like to correct this inference.—I am, Sir your obedient servant,

C. J. S. GOUGH,
Lieut.-General, V.C., G.C.B

Experiments with the Lee-Metford Rifle.—The following interesting notes of some experiments recently conducted at the Royal Military College with the ·303 Lee-Metford rifle, cordite ammunition, have been communicated for publication:—

	Description of Target.	Penetrations. 6th March, 1895.	Penetrations. 7th October, 1895.
1	A wicker gabion filled with damp sand... ...	Bullet through and lost	Through and lost.
2	Solid wall of sandbags	28 inches into wall ...	30 inches into wall. (*a*)
3	A mound of loose sand	Through 3 feet and lost	Through 4 feet and lost.
4	A mound of loose shingle of $1\frac{1}{2}$-inch gauge... ...	4-inch bullet broken into shavings	6-inch bullet broken up fine.
5	Matchboard wall 3 inches apart, filled with shingle of $\frac{1}{2}$-inch to $1\frac{1}{2}$-inch gauge	Bullet just through ...	Bullet right through.
6	As in No. 5, but walls $4\frac{1}{2}$ inches apart	Bullet not through ...	Bullet lodged in back-board, just starting it.
7	Matchboard walls $4\frac{1}{2}$ inches apart, filled with shingle of $\frac{1}{2}$-inch gauge	Bullet went through ...	Bullet right through.
8	As in No. 7, but walls 6 inches apart	Bullet not through ...	Bullet lodged in back-board.
9	Matchboard walls $4\frac{1}{2}$ inches apart, filled with shingle of $1\frac{1}{2}$-inch gauge	Bullet just failed to get through	Bullet clean through.
10	As in No. 9, but 6 inches apart	Failed to go through ...	Penetrated 5 inches.
11	Fir-tree logs	Through 27 inches—lost	Through 37 inches—lost
12	Oak-tree logs	Through 16 inches—lost	Penetrated 20 inches (*b*)
13	Stockading of 56-lb. rails (steel)	Rail dinted	Rail dinted.
14	A 14-inch brick wall—stretcher brick	Penetrated $3\frac{1}{2}$ ins. (Soft brick.)	Penetrated 3 ins. (Hard brick.)
15	A 14-inch brick wall—header brick	Penetrated 5 „ (Soft brick.)	Penetrated $2\frac{1}{4}$ „ (Hard brick.)
16	A 9-inch brick wall—stretcher brick	Penetrated 4 „ (Soft brick.)	Penetrated 3 „ (Hard brick.)
17	A 9-inch brick wall—header brick	Penetrated 5 „ (Soft brick.)	Penetrated $2\frac{3}{4}$ „ (Hard brick.)
18	A $\frac{1}{4}$-inch steel plate ...	Punched a clean hole...	Clean hole.

(*a*) The path of these bullets was never straight. In the 30-inch penetration the bullet went straight for 20 inches, then turned at right angles for 8 inches, and then turned again at right angles towards the firing point for 2 inches more, and was found undeformed.

(*b*) This target consisted of two trees, each 12 inches in diameter, placed one behind the other. The bullet went through the centre of the first, and on entering the second turned sharply to the right at about an angle of 120 degrees, traversing another 8 inches of oak, where it was found undeformed.

NOTE.—The range was 20 yards, except for experiments 14 to 17 inclusive, when it was only 12 yards.

Notes on Field Equipment for Ashanti.—In view of possible operations on the Gold Coast, the following notes, compiled from the back numbers of this Journal, may be found of service.

Only coolie carriage being available, it is obvious that the reduction of weight in the things to be carried is of more than usual importance. Thanks to the great strides that have been made in the manufacture of aluminium during the past eighteen months, a reduction of two-thirds can be made by substituting this metal for iron or tin, in all cooking gear, canteens, water-bottles, etc. The things now made will stand rough usage, and experiments extending over a long period made in the Berlin hospitals prove that, with even moderate attention to cleanliness, no injurious chemical action results from the acids, etc., contained in the foods attacking the metal, and even where discoloration ensues, from leaving the food or fluid too long in contact with their receptacle, no poisonous qualities are developed. All these articles can be obtained from either the Army and Navy Stores, or the Military Equipment Company, 61, Pall Mall.

The most dangerous enemy we shall have to contend with is, undoubtedly, the malaria. Without going into the medical side of the question, it may be sufficient to recall the remarkable results obtained by Dr. Hafkine, in India, by the use of permanganate of potassium in sterilising well water; a full account of these experiments appeared in the Military Notes of this Journal for August. By a printer's error the name Hafkine has been rendered Hankin. The results obtained by the Austrians from the use of chloride of lime for the same purpose should also be noted. Weaver's ferric periodate crystals were severely tested as a cure for cholera in the Hamburg epidemic, and with very satisfactory results. It is further claimed for them that they will act as a preventative of malarial fever, and, indeed, against any disturbance of the system having its origin in the presence of bacilli in the intestinal canal. They can be obtained from any chemist by asking for periodate crystals.

The extraordinary properties of kola in enabling one to endure hunger, thirst, and extreme exertions, are beginning to be better known. It comes originally from the Gold Coast, but it is well to bear in mind that there are two kinds in the market, the true kola and the false, and that the natives are quite sharp enough to palm off the latter on the unsuspecting buyer, unless he has an expert friend at hand to advise him. Since, apparently, all the good properties of the article can be obtained by using a mixture of theobromine and caffeine, it might be well to have a few powders made up in England, two grains of theobromine to six of caffeine, to hold in hand as a last reserve. Double this dose can be taken without danger, but it is hardly a pleasant experience.

Finally, though I can recall no positive cases of sunstroke in the last campaign, yet the Gold Coast being almost under the line, the intensity of the sun's rays is very great, and exposure to them aggravates immensely the lassitude and weakness due to fever or dysentery. From personal experience extending over some six years in India I can absolutely certify to the enormous relief the use of an orange or ruby-coloured lining to one's helmet and coat affords. The theory of its action is identical with the reasoning which leads the photographer to protect his sensitive plates from sunlight by wrapping them in ruby or yellow paper, and developing his plates under a red light; and since, nowadays, almost everyone is a photographer, further explanation will be unnecessary. F. N. M.

The following tabular statement has been drawn up by Captain Gaynor, R.E., and gives the result of the experience acquired during the recent manœuvres in the South-Eastern district with steam transport on common roads. The shortening of the column, it will be noticed, effected by the use of the locomotive, is in round numbers one-third, and with the engines now in use in France, indeed in all countries unhampered by the English Road Locomotive Act, the speed may safely be doubled. Apply the figures given below to the situation of trains of Prince Frederick Charles Army at the defile of Kaiserslautern, in the early days of the Franco-German campaign, and the result will be simply startling.

FOR TRANSPORTATION OF ONE HUNDRED TONS.

By Steam Transport, allowing 5 Tons per Wagon.

5 trains, each of 1 engine and 5 tenders, driven by—
1 N.C.O. and 3 men for each train, and 1 sergeant in charge; total 1 sergeant, 5 corporals, and 15 sappers.

Occupying a length of road per train—

1 engine, 16 feet	=16 feet.
5 tenders, 18 feet	=90 feet.
	106 feet = $35\frac{1}{3}$ yards.

Between trains an interval of 50 yards, length of convoy becomes—

5 trains at $35\frac{1}{3}$ yards	= $176\frac{2}{3}$
4 intervals at 50 yards	= 200
	$376\frac{2}{3}$ yards.

Costing for plant—

5 engines at £600	= £3,000
25 tenders at £65	= 1,625
	£4,625

Costing daily for fuel and food of drivers—

5 engines at 5 cwt. coal per diem	= £1 5 0
21 rations at 6d.	= 10 6
	£1 15 6

21 men could probably forage for themselves *en route*, if given the money allowance.

There are, including the engines, 120 wheels to cut up the roads and get out of order.

By Horse Transport, allowing $1\frac{1}{2}$ Tons per Wagon.

6 trains of 11 wagons, with 4 horses in each, driven by—
132 drivers, with a proportion of officers, warrant officers, farriers, etc.

Occupying a length of road per train—

11 wagons at 12 yards	= 132 yards.
10 intervals at 4 yards	= 40 yards.
	172 yards.

Between trains an interval of 50 yards, length of convoy becomes—

6 trains at 172 yards	= 1,032
5 intervals of 50 yards	= 250
	1,282 yards.

Costing for plant—

264 horses at £40	£10,560
264 sets of harness at £9	2,376
66 wagons at £100	6,600
	£19,536

Costing daily for food of men and horses—

132 rations at 6d.	£3 6 0
264 horses at 1s. 3d.	16 10 0
	£19 16 0

132 men and 264 horses require special transport for their food in addition to above.

There are 1,056 hoofs and 264 wheels to cut up the roads and get out of order.

H. F. GAYNOR, *Capt., R.E.*

THE AUSTRO-HUNGARIAN CAVALRY.

In continuation of his article on the Austro-Hungarian cavalry, reprinted in last month's issue of the Journal, the same correspondent of the *Times* sends the following very interesting notes on the system of Government studs existing in that country. Those officers desiring further information on this subject will find it in the work recently published at Vienna in four volumes, by Graf Wrangel, well known as an expert in his own country. These volumes give full details as to the expenses and returns, together with lists of all the stallions with the portraits of the most celebrated amongst them.

"The present very efficient state of the Austrian cavalry was dwelt upon in a letter on the recent Hungarian cavalry manœuvres, published in the *Times* on October 3rd. It was therein mentioned how, despite exceptionally long marches in trying heat, at the close of some eight weeks' hard manœuvring the horses looked in perfect condition, fit for anything, bright in coat and well covered with flesh.

"Certain reasons of great importance, and all worthy of attention, from a military point of view, were given for this most desirable state of perfection. But others remain to be mentioned, constituting lessons for careful study on the system which has brought this about. A wise nation will apply to her army any of them which may be found adaptable to her own particular characteristics.

"The first and most important point is so rudimentary that its mention might, at first sight, appear to be wholly superfluous. But experience shows it to be much neglected and, to a great extent, left to chance by some nations priding themselves on possessing good cavalry. It is based on the fact that a good cavalryman on a bad horse is of no more use than a good infantry shot armed with an indifferent rifle—neither being of much, save on paper. This once grasped, it becomes self-evident that the first necessity to improve the mounted arms is to raise the breed and increase the numbers of suitable horses throughout a country until the desired standard be attained. On the Continent this matter is now receiving well-deserved attention. The breeding of army horses is being enormously developed with more or less successful results. In no country, however, has the question been so carefully studied as in Austria, where the Government has, through a wise system of encouragement afforded to the farmer, converted the vast, open plains of Central and Southern Hungary into the breeding grounds of the best cavalry horses in the world. A visit to these parts soon convinces one of this. The most striking thing to the horse-loving traveller is the number of well-bred, well-shaped horses seen, and the dearth, of course, of hairy-heeled ones. Good animals, mostly of the stamp of smart, medium-weight hunters, abound, everywhere. They are met with grazing in groves across the open plains, or trotting briskly along, generally in pairs, drawing the light, wooden-framed farm wagon of the country, followed, as a rule, by a foal or yearling. The young stock thus accompany the dam, feeding by the road-side, then trotting or galloping along to catch up the parent, becoming active and hardy and, at the same time, docile and tractable through the frequent visits made in this manner to the neighbouring villages or towns.

"There are nine large studs in Hungary, besides two large and six smaller ones in Austria. These are under the Agricultural Department, but have been managed since 1866 entirely by military stud corps. They were formed by the Emperor Joseph II. 'to raise the breed of horses and to improve the mounting of the army.' At these establishments a certain number of horses are bred, and thoroughbred stallions, many of them English, are maintained and sent round the country to different centres, for the service of farmers' mares, at nominal fees. The Government has first call on the produce, which is purchased direct from the breeder at from five years old—exceptionally at four-and-a-half—up to seven, at prices varying annually, but fixed for 1895 at between £16 and £32, so that the

average may not exceed £25 on allotment to corps after all expenses have been defrayed.

"There are, besides these studs, three remount depôts where horses found to be exceptionally good, and bought, consequently, at three-and-a-half, are kept while maturing. The average price sanctioned for artillery draught horses in 1895 is £28. The purchases are made by standing committees, of which there are at present six, at central places in Hungary. Regiments may purchase horses direct, if of a very superior class. Twelve per cent. of riding and 10 per cent. of draught horses may be cast annually, so that practically no cavalry horse serves more than eight years in the ranks or is over thirteen years of age. At the prices stated above the Hungarian cavalry horse is far superior to the average animal of the same arm in England. The reasons, stated briefly, for this are the great care bestowed on horse-breeding by the Government in Hungary, the assistance given through the cheap service of thoroughbred Government stallions, the claim thereby established of first call on the produce, and the purchase direct without the expensive intervention of the middleman. All old and useless horses being eliminated through the weeding out of 12 per cent. annually, only thoroughly sound, serviceable animals remain in the ranks. They average 15·1½ or 15·2 in height.

"It cannot be objected that the points mentioned above are inapplicable to our chief horse-breeding country—Ireland. The system has only to be vigorously adopted for it to prove its own success within three or four years. The one thing necessary is the initial sum required to start a couple of remount depôts and to purchase the requisite number of stallions. The latter would pay for themselves; the former would, with the other matters mentioned, economise a large proportion of the present remount expenses, and within five years the breed of Irish horses of the trooper class, now rapidly degenerating in quality and diminishing in number, would be materially improved.

"The Irish breeding farmer at present selects his own stallion, which, owing to 'hard times' and the scarcity of thoroughbred sires in the country, is generally the cheapest procurable. His profit is so small, the middleman getting the lion's share of this, that he hesitates to pay a large fee for the chance of a trifling ultimate gain. But this would no longer be the case under the system adopted in Hungary, when thoroughbred sires would be obtainable at a lower rate than the present half-bred ones, and with the prospect of a certain sale for the produce at an enhanced profit. It is not rash to predict that the supply would double within five or six years, as anyone acquainted with Ireland knows well that at present the ordinary farmer has almost given up horse-breeding as a paying concern, and carries it on only to the extent of an annual foal for farm or personal hunting purposes. The great economy effected by the introduction of remount depôts, where horses can be kept until five years old, must not be lost sight of, if it be granted that horses must be purchased at four or younger, so as to secure them for sale to civilian purchasers. In no continental nation are horses worked for cavalry purposes until five years old. The luxury is found to be too expensive. An initial sum is voted, young horses are purchased, and sent to depôts to mature. It requires but a tyro in equine matters to know that a horse subjected to severe work, carrying a heavy load, at the age of three off, before he is fully grown or matured, must suffer under the strain. As a matter of national economy, therefore, the allotment of horses to corps is deferred on the Continent until the age of five, and, even then, no horse under six is allowed to accompany the unit to manœuvres in the field. There is another consideration not to be overlooked in considering the best stamp of horse for cavalry purposes, which is that a well-bred horse, besides the advantage of supporting the strain of hard work at a fast pace better than its coarser comrade, is also far handier and easier to ride and manage in manœuvre. The well-bred ones may be a bit hotter and keener, but they are not awkward in the ranks. Be it said in praise of our cavalry soldiers, as horsemen,

that if they were mounted on Hungarian cavalry horses they would defy comparison in Europe. For every reason, therefore, both financial and military, the improvement of the breed and supply of horses for cavalry purposes is one of the most important military questions of the day.

"The means adopted to insure a supply of trained reserve cavalry horses in Austria and Hungary also affords a useful and interesting study. It must first be mentioned that there are two distinct classes of reserve—the first a reserve of men and horses for the active regiments; the second, a similar supply formed into a distinct body of reserve or, as it is called in Hungary, Honved cavalry. To the first class belong, for seven years, those men who have served in the active army for three years, while the second class is composed of men who have passed out of the first. The reserve of horses is formed for both by the purchase, in peace time, of a certain percentage of remounts more than those required to supply the place of deficiencies, and, on the outbreak of war, by the compulsory calling in, at prices fixed by the State, of any suitable animals which the exigencies of the moment may require. A register is kept for this latter purpose, and a searching triennial inspection of all animals thereon made. There are 3½ million horses in the Dual Empire, besides some 80,000 mules and donkeys.

"To avoid the expense of maintaining the extra horses purchased annually, the State gives them out, after they have been trained for military purposes, to approved civilians, who are allowed to use them in return for their keep. They are inspected in the spring and called up for four weeks' annual training or manœuvre in the autumn. If they are not found to be looking well a fine is imposed, or, if necessary, the horse must be replaced, while a reward is given to deserving caretakers. At the end of six years in Austria, or five in Hungary, if the horse is turned out annually in exceptional condition, the animal becomes the property of the caretaker. The annual percentage of horses thus farmed out is made up in corps by remounts.

"It may be objected that this latter system appears to be an expensive one. To judge by those Honved horses seen, and by the opinions expressed by competent judges, it is an admirably successful one, and a country like Austria, whose army is in a most excellent state and whose military estimates compare favourably with those of other Powers, has, doubtless, considered very carefully the question of cost in relation to efficiency. It may be that she has arrived at the decision that an expensive reality is better than a costly sham, and with this opinion no one can find fault."

With reference to the suggestion that the same system might with advantage be applied in Ireland, we express no opinion; but we have little doubt that if the Native Cavalry regiments in India, following the example of the 11th Bengal Lancers, were each to institute a stud farm on the lines above indicated, receiving Government assistance in the raising of capital for first expenses, Government would find it a very satisfactory investment indeed, and the hard-pressed Chunda funds would obtain great relief.

GERMANY.—*The Imperial Manœuvres.*—No more interesting manœuvres for Englishmen have taken place in Europe during the past twenty-five years than those held this year in the neighbourhood of Stettin, and we particularly regret that the limits of available space absolutely preclude us from reprinting the excellent account of them furnished by the *Times* special correspondent. The point of interest for us lies in the fact that they were based on the assumption of a disembarkation on the Baltic coasts, and from the general and special ideas we can derive some idea of the degree of rapidity with which the German staff expect that an advance after disembarkation can be made. Briefly, the invaders landed at two points, Stralsund and Colberg, and on the fourteenth day a decisive action was fought at

a distance of, approximately, 115 miles from the former place, or seventy-five from the latter. Read Bournemouth for Stralsund, Brighton for Colberg and plotting these distances on the lines from both places towards London, note the consequences for the metropolis. Further, note the suddenness with which the attacks are launched. Long lines may be in action for hours, but not till the last moment has arrived is an infantry soldier seen, and then half an hour decides one way or another.

His fourth letter is, on the whole, the best piece of work we can ever recall having seen in any newspaper. More brilliant prose may, of course, have been written, but this one shows a completeness of grasp altogether unequalled. It gives the whole spirit of the German Army. Attack! always if you can, but when circumstances compel you to stand on the defensive, use the spade to set free your troops for a vehement counterstroke to destroy your enemies' arrangements; how very different from the "dig your own graves deeper" theories in vogue in so many other armies. Better still, he shows us with great clearness and force that after all, this is no new idea, but is simply the application of the old practice of the Iron Duke and his Peninsula-trained armies adapted to modern times and modern ranges. His references to Salamanca and Waterloo are particularly happy. If no other evidence were available, the fact that the daily press will throw open its columns to such sound criticism and common sense shows how very far we have advanced in the reconstruction of our army during the last twenty years.

Paper Underwear for Soldiers.—Professor Joest, of Berlin, having received samples of the paper underclothing provided for the Japanese troops during the recent winter operations, a few sets were issued to the 2nd Guard Uhlans. The results did not prove satisfactory, as they barely lasted three days. But the fact that paper is an excellent non-conductor, and does really retain the heat of the body, is one well worth bearing in mind when campaigning in severe weather.

RUSSIA.—*The Trans-Caspian Army.*—The strength of the troops quartered in Central Asia, in 1895, is given in the German *Neue militärische Blätter* as thirty-two battalions, thirty squadrons, ten batteries, one half-battalion of fortress artillery, and two and three-quarter technical troops—in all, 36,000 men and sixty-eight guns.

Siberia.—According to the *Revue Militaire de l'Étranger,* the artillery in Eastern Siberia has been reinforced by two batteries during the past few months, and consists now of eight field batteries, two howitzer batteries, and two half-batteries of mountain guns.

FOREIGN PERIODICALS.

NAVAL.

AUSTRIA-HUNGARY.—*Mittheilungen aus dem Gebiete des Seewesens.* No. 11. Pola and Vienna: November, 1895.—"The Naval operations in East Asia" *(continued).* "The Sea-fight off Actium." "Types of English Cruisers" (with photographs). "The Trials of the 'Sokol.'" "Foreign Naval Notes." "The state of the French Submarine Defences." "The Norwegian Naval Budget, 1895-96." "The Nicaraguan Canal." "Book Notices."

FRANCE.—*Revue Maritime et Coloniale.* Paris: October, 1895.—"A Study of the Electric Gyroscope." "Statistics of Shipwrecks and other Casualties at Sea during 1893." "Grave Defects in rapid Cruisers." "The grounding of the Italian battle-ship 'Sardegna' in the Great Belt." "The Circulation of Winds and Rain." "Naval Foreign Notes." "Notices of Books." "The Sea Fisheries."

Le Yacht. Paris: 5th October, 1895.—"The 31-knot torpedo-boat 'Forban.'" "Official trials of the 'Forban.'" "Yachting Notes." "The English cruiser 'Terrible.'" "The American cruiser 'San Francisco'" (with photograph). "Naval Notes, Home and Foreign." 12th October.—"The cost of Ships of War," translation of Professor Elgar's paper. "Yachting Notes." "The German battle-ship 'Sachsen'" (with photograph). "The English cruiser 'Terrible'" *(continued).* "Naval Notes, Home and Foreign." 19th October.—"The cost of Ships of War" *(continued).* "Yachting Notes" (with plans and photographs). "The English cruiser 'Terrible'" *(concluded).* "Naval Notes, Home and Foreign." 26th October.—"The new Torpedo-boats and Torpedo-boat Destroyers." "Yachting Notes." "The new third class cruiser 'Linois'" (with instantaneous photograph of ship steaming 20·6 knots). "Naval Notes, Home and Foreign."

Le Moniteur de la Flotte. Paris: 5th October, 1895.—"The Colonial Army" (Marc Landry). "Colonial Notes." "Naval Notes, Home and Foreign." 12th October.—"The Names of Ships of War." "Colonial Notes." "The War in Madagascar." "The New Constructions in 1896." "Naval Notes, Home and Foreign." 19th October.—"The Naval Divisions" (Marc Landry). "The Colonies." "Madagascar." "Naval Notes, Home and Foreign." 26th October.—"The Budget of 1896" (Marc Landry). "The Colonies." "Madagascar." "Naval Notes, Home and Foreign."

La Marine Française. Paris: 10th October, 1895.—"The Mail Boats of the Future." "The Tactics of Battle" (Commandant Z. and H. Montéchant). "Cruiser Warfare." "The English Naval Manœuvres" *(concluded).* "Retrospective Notes on Battle-ships" *(continued).* "Trials of the 'Forban.'" "Merchant Navies and Foreign Commerce." "Official Documents in connection with the state of the Navy." 25th October, 1895.—"French Traditions." "The Tactics of Battle." "Retrospective Notes on Battle-ships" *(continued).* "Our Squadron Manœuvres." "The Japanese Merchant Navy." "Naval Notes, Home and Foreign." "Official Documents in connection with the state of the Navy."

GERMANY.—*Marine Rundschau.* Berlin: November, 1895.—"The Education and Employment of Specialists among Naval Officers." "The History of Kiel Dockyard" (with plan). "Report of the Commander of H.M.S. 'Cormoran' of visit to Persian Gulf to the Minister of Marine." "Report of Senior Naval Officer on the East-Indian Station on Admiral Rawson's Expedition against Mwele." "Foreign Naval Notes."

ITALY.—*Rivista Marittima.* Rome: October, 1895.—"Lateral Oscillations in large ships." "The Tactical Employment of Torpedo-boats." "The Consular

Capitulations." "South America and Italian Commerce." "The Naval Situation in the Mediterranean" *(continued)*. Letters to the Director :—"Naval Historical Studies in Italy"; "The Mechanical Applications of Electricity on Ships of War." "Naval Chronicle—Home and Foreign" (with photographs of "Caprera" and "Latouche-Tréville"). "Notices of Books."

RUSSIA.—*Morskoi Sbornik.* St. Petersburg: August, 1895.—"Instruction on the Laws regulating Capture at Sea." "The Naval War between Japan and China." "The Current in the Bosphorus."

SPAIN.—*Revista General de Marina.* Madrid: October, 1895.—"The Grand General Staffs." "The 'Magnificent.'" "Elementary Electro-Dynamics." "Observations of Precision with the Sextant." "Vocabulary of Powders and Modern Explosives." "Naval Notes—Home and Foreign." "Notices of Books."

MILITARY.

AUSTRIA.—*Organ der militair-wissenschaftlichen Vereine.*—The entire number is taken up with a history of the operation of the German armies in France after Sedan (with maps).

Mittheilungen über Gegenstände des Artillerie- und Geniewesens. No 10.—"Investigations into the action of the striker in time fuses"; a stiff mathematical paper. "European Pontoon-trains" (with plates) (*to be continued*); worth the attention of Engineer Officers. "The ammunition of the Italian 9-centimetre M. Siege Mortar" (illustrated). "Ventilation of Barrack-rooms." "Notes," etc.

FRANCE.—*Revue Militaire de l'Étranger.* October.—"The Development of Railway Communications in Alsace-Lorraine" (with maps); a valuable study. "The Defences of the Swiss Frontiers" (with maps and plans).

Journal des Sciences Militaires. October.—"Against the system of Two Years' Service," by General Lewal. The author's name should suffice to compel attention; the article has been much discussed in the German military press. "The Training of the Company for War." "The Field Gun of the Future" (*continued*). "Weissenburg — Froeschweiler — Chalons — Sedan — Châtillon — La Malmaison." Reply to criticisms in the *Spectateur Militaire* on certain articles which appeared in the *Journal des Sciences Militaires.* "The Campaign of 1814," by M. Weil. "General Alexis Dubois."

Le Spectateur Militaire. 15th October.—"Increase in the Cadres of the Engineers." "The New Field Service Regulations," by Noel Desmaysons." "The Age Clause." The French are suffering much from the block in promotion, the age of their superior officers compares very unfavourably with the state of affairs in Germany and Austria. "Tramways for Military Purposes." "The Autumn Exercises of the Sanitary Corps"; read.

Revue du Cercle Militaire. 5th October.—"The causes of defeat"; review of a recent pamphlet on Jena, published in Germany, worth reading; the pamphlet is based on the works of Höpfner, von der Goltz, and Lettow-Vorbeck. "War Office Reform in England," by Paul Ettinghausen, a reserve lieutenant of the French Artillery; shows considerable appreciation of British circumstances. "News from Madagascar." 12th October.—"A comparison of the French and German Manœuvres"; *résumé* of the articles in the *Army and Navy Gazette* and the *Times.* "Reforms in the War Office" (*concluded*). 19th October.—"The folding bicycle in the Grand Manœuvres"; report of further experiences, satisfactory; special attention is called to this article, and preceding ones on the same subject. "The new Musketry Regulations." "News from Madagascar." 26th October.—"The folding bicycle in the manœuvres" (*continued*).

L'Avenir Militaire. 1st October.—"The Engineers, The African Army and the Budget Commission," by General Cosseron de Villenoisy; characterised by this well-known officer's usual common sense. "Recruiting for the Marines"; our neighbours are beginning to experience some of the same difficulties which beset us in the provision of a foreign service army. "The Military Administration and the Report of M. Cavaignac"; deserves the most attentive reading. 4th October.—"The Intendance and the Report of M. Cavaignac"; leader on M. Cavaignac's report. "The Army Estimates." "The Marine Infantry in Paris." "From Madagascar"; a single melinite shell is alleged to have produced perfectly astonishing results, fully justifying the confidence the French artillery place in it. Perhaps some day we shall learn to fire high-explosive shells. 8th October.—"France at Tananarivo," from *Le Temps*, the *Times*, and *Le Petit Journal;* nothing new. "Calling out the Reserves"; complains of the time of year chosen. "Madagascar"; wants to know why a railway was not made. This is the line this paper has always taken. 11th October.—"The Administration of the Army"; more about M. Cavaignac's report. "Military Spies." "The Political Situation in Europe"; somewhat alarmist in tendency. "Madagascar." "Details of the Schwartz Case." "The Cypher Despatches of Louis XIV." 15th October.—"M. Cavaignac's Report," warmly praising the line taken by this gentleman in disclosing abuses. "Généraux d'opérette"; satirises certain tendencies in the French Army. "The Grand Manœuvres," summary of a paper by Colonel Patray in the *Revue Bleu ;* the colonel's conclusions should be compared with some of the opinions which have appeared in the British press; he is not so easily satisfied. "Cypher Cablegrams," by an expert; worth study. 18th October.—"A Colonial Army," based on M. Cavaignac's report; worth reading. "The Proposed Military Law in Switzerland." 22nd October.—"Recruiting for the Colonial Army as it exists at present"; worth reading. "Responsibility for Madagascar." "The Army at the Circus"; a strong indictment of the principle of the Military Tournament. 25th October.—"The Legion of Honour." "The Future Recruiting of the Colonial Army." 29th October.—"The Military Doctor." "The 19th Corps d'Armée," based on M. Cavaignac's report.

Revue d'Artillerie. October.—"Theoretical investigation of the Field-glass, with special reference to a method for extending the field of view and the power"; a highly technical study, worthy the attention of specialists. "The Corps of Artillery of France" (*continued*); a very interesting historical study. "A Mechanical Calculator (abacus) for the direction of siege artillery fire"; a study of the graphic method as applied to artillery problems; very mathematical. "Field Artillery fire in Russia over snow, and in periods of intense cold"; an interesting *résumé* of recent experiments.

Revue du Genie. September.—"A Study on intrenched camps," by Captain Sandier. "Review of the History of Danzig and Weichselmünde, by General Kohler." "General Brialmont's latest work, 'La défense des États.'" October.—"History of the Siege of Puebla, 1863." "The defensive organisation of Russia." "The new organisation of the Engineers in Switzerland." "Effects of high explosives on vaulted buildings, etc." "Cutting wire cables by explosives." "Construction of bridges at the Isle of Lobau"; before Wagram; swinging the bridge.

GERMANY.—*Neue militärische Blätter.* October.—"Russia and England in Central Asia"; summary of the existing situation, from well-known sources, and with no originality. "The French Expedition to Madagascar" (*to be continued*). "Dragomirow's Methods of Military Training." "The Experimental Mobilisation of Two Cavalry Regiments in France"; compilation from French sources. "The Tactics of the Russian Artillery"; read. It is stated that the field artillery is not yet provided with high-explosive bursters; this may be, but the siege artillery certainly has been for some years. "Organisation of the Lines of

Communications in 1870-1." Correspondence: Letter from France, summarises the internal condition of the French Army, as revealed by the military and lay press; should be studied.

Militair-Wochenblatt. 2nd October.—"The Cavalry Manœuvres in France," translated from *La France Militaire*, gives the Inspecting Officer's remarks in full; worth careful study. "Progress in the Russian Field Artillery"; summary of a lecture by the well-known Russian Artillerist, General Engelhardt; read. "A new bit for horses that get their tongues over their bits." 9th October.—"Cavalry and Horse Artillery on the Battle-field"; very suggestive. "Notes on the French Field Artillery"; gives rules for ranging, cones of dispersion of shrapnel, and some hints on the use of the melinite shell. "The Geneva Convention." 12th October.—"Did the Baireuther Dragoons wear white or blue tunics in the battle of Hohenfriedberg?" 16th October.—"The Norwegian-Swedish rifle question." 19th October.—"The Italian Manœuvres." "The new French Regulations for Field Service." 23rd October.—"A field hospital in 1870-1"; recollections of Surgeon-General Knoevenagel; interesting. "New formations in the Russian Cavalry and Artillery." 26th October.—"The battles of General Werder in 1871." "Horse insurance for members of the German Army." 30th October.—"General von Goeben"; review of his life, recently published by Mittler.

Deutsche Heeres Zeitung. 2nd October.—"Q.F.'s for Field Artillery"; comments on recent articles in *L'Avenir Militaire*, already noticed in these pages. "Derfflinger as a Cavalry leader," the well-known Swedish General in the Thirty Years' War. 5th October.—"American torpedo-boats," refers to the "Vesuvius," with Zalinski guns; considers them a hopeless waste of money; deals disparagingly also with the true American-built torpedo craft. 9th October.—"Cavalry and long lines of guns"; *résumé* of some Russian views. 23rd October.—"The French Grand Manœuvres"; from the *Cercle Militaire*. 26th October.—"Fortress Warfare"; review of a new Belgian work. 30th October.—"The Austrian troops in the Manœuvres of 1894 between Bruck and Landskron"; review of a book by Lieutenant-General von Roessel, of the Prussian Army, discussing various questions of tactics and organisation; final verdict very favourable; should be compared with the articles of the *Times* Correspondent, reprinted in the January and February numbers of the JOURNAL. 2nd November.—"Is a crisis in the French Military Organisation imminent?" should be carefully read; is based throughout on French sources, and shows intimate knowledge of French conditions.

UNITED STATES.—*Journal of the U.S. Cavalry Association.* September.—"The Training of the Recruit." "Conversations on Cavalry," by Prince Hohenlohe; 13th Chapter: The training of men and horses (translated by Lieutenant Reichman). "The Officers' Patrol." "The Siege of Chitral," by Lieutenant C. G. Stewart, R.A. Professional Notes:—How the 1st Maine Heavy Artillery lost 1,179 men in thirty days, deserves to be read and compared with the tales of slaughter of more modern breech-loading days.

The United Service. October.—"The Regiment of Mounted Infantry, or from Pueblo to the City of Mexico." "Chronicles of Carter Barracks" (fiction). "The Maryland Line." "The Japanese Imbroglio"; reprinted from *Blackwood.* "Our Frontier Canals"; foretells war between the States and England on completion of the Nicaragua Canal. "Slaving labourers and the 'hired soldier.'" "Notes," etc.

NOTICES OF BOOKS.

Nelson. (Men of Action Series.) By JOHN KNOX LAUGHTON, R.N., Professor of Modern History, King's College, London. Macmillan and Co., 1895.

Anything emanating from the pen of Professor Laughton is sure to be of interest, and his life of Nelson is no exception to the rule. It is not only a fascinating little volume, but it is of great value to students of that period, presenting, as it does, in a concise and very readable form, not only the operations in which Nelson himself actually took part, but a general survey of the naval theatre of the war as a whole.

The author does not waste much time over the earlier stages of Nelson's career, being of opinion that the important era in his life began when, as a captain of fourteen years' standing, after five years of half-pay, and at thirty-four years of age, he commissioned on January 30th, 1793, the "Agamemnon," a 64-gun ship, to form part of the squadron proceeding to the Mediterranean under the command of his old chief, Lord Hood, who had just been appointed to the chief command on the outbreak of the new war with France.

There is one point, however, during his earlier services, to which Professor Laughton draws marked attention, and that is the tendency Nelson had already displayed to disregard the orders of his senior officer, when they clashed with his own views. As a young captain in command of the "Boreas" frigate he twice deliberately set at nought the orders of Sir Richard Hughes, the Commander-in-Chief in the West Indies, with the result that he was reprimanded by the Admiralty; and the fact that he was kept so long unemployed after the paying off of the "Boreas" was quite possibly due to the Admiralty, "being not altogether pleased with his conduct, and looking upon him as a man likely to give trouble in time of peace by excess of zeal." Professor Laughton rightly points out that the first duty of an officer is to obey orders, unless some sudden and unforeseen emergency forces him to depart from his instructions—an excuse, however, which was wanting to Nelson in the two incidents referred to.

There seems to be no doubt that he was an extremely popular Captain, and Professor Laughton mentions one trait in his character which very probably was one of the causes of his being so. He started with the belief that his officers, men, and the ship herself, were the very best in the Service, and he let his subordinates know what his opinion was, and that he considered it impossible he could be mistaken in them. The author points out that "in reality, of course, both officers and men were at first much the same as those of the other ships, commissioned at the same time, and manned in the same way. What they were after they had been a couple of years under the influence of Nelson is a very different thing." During the eighteen months which elapsed between the entry of the fleet into the Mediterranean and the return to England of Lord Hood, Nelson was employed on independent service, during which he assisted in the reduction of Corsica, losing his right eye at the siege of Calvi. Hotham, who succeeded Hood in the chief command, although he had distinguished himself during the American War, and was considered a good officer, does not seem to have been well fitted for the duties he had now to undertake; and Nelson expressed his feelings as to his incapacity pretty freely. On two occasions, in Nelson's opinion, Hotham could have destroyed the French fleet; but the opportunity in each case was thrown away. Professor Laughton agrees with this view, and considers that had the French fleet been destroyed on 13th July, 1795, as it ought to have been, that the whole course of history would have been altered. "Italy could not have been invaded; Spain would have remained true to the English alliance; and the French expedition to Egypt would have remained undreamt of."

In December of the same year Sir John Jervis superseded Hotham, and speedily introduced new life into the fleet, bringing it into a state of "unparalleled efficiency." The new Commander-in-Chief seems from the first to have conceived a high opinion of Nelson's capacity. In August, 1796, he ordered him to hoist the broad pendant of a first-class Commodore, and entrusted him with the duty of carrying out the evacuation of Corsica, rendered necessary by Spain having joined France; an alliance which, moreover, compelled the Admiral with the whole fleet, now reduced to fourteen line-of-battle-ships, to fall back on Gibraltar. On the 14th February, 1796, came Nelson's first great chance, when Jervis, with only fifteen sail of the line, attacked and defeated the Spanish fleet of twenty-seven ships of the line off Cape St. Vincent. Although the odds against him were excessive, Jervis felt it was necessary, at all hazards, to prevent the Spaniards from reaching Brest. "A victory is very essential to England at this moment," he was heard to mutter as he paced the deck of the "Victory." Nelson's part in the action, and how in the "Captain" he captured first the "San Nicolas," and then the "San Josef," is too well known to need comment. For his services on the occasion he was made a Knight of the Bath, having become a Rear-Admiral a few days after the battle, after seventeen years' service as a Captain, and being at that time thirty-eight. On 24th July came the unfortunate attack on Tenerife, where he lost his right arm, and which necessitated his being invalided to England to recruit his health. In April of the next year, 1798, he hoisted his flag in the "Vanguard," and sailed to again rejoin Lord St. Vincent, who at once sent him into the Mediterranean to watch the French fleet, then fitting out at Toulon. A heavy gale on the 20th May, in which the "Vanguard" suffered a good deal, drove Nelson and his squadron to Sardinia to repair damages; and on returning to Toulon a fortnight later, it was to find the French flown. Then came the two months' chase up and down the Mediterranean, followed by the great battle in Aboukir Bay, on the 2nd and 3rd August, when out of seventeen line-of-battle-ships and frigates under the command of the French Admiral only four escaped. The English fleet consisted of fourteen ships of the line, so the French had a slight superiority; but Professor Laughton considers this superiority more apparent than real, as many of the French ships were old, were hardly seaworthy, and could only carry a reduced armament, while the crews were newly raised, badly trained, and in a bad state of discipline.

It was after this battle that Nelson's acquaintance with Lady Hamilton practically began, and Professor Laughton gives some interesting details of that lady's history, of whom he entertains but a low opinion. He considers her a clever, unscrupulous woman, who had got it into her head that she had rendered very important services, and who did not scruple at any untruth to maintain the fiction. As for Nelson's relations with her, there seems to be no doubt, but Professor Laughton is of opinion that Lady Nelson had only herself to blame for the estrangement between herself and her husband. It is satisfactory, however, that Professor Laughton is able to show that the charges made by Southey against both Nelson and Lady Hamilton in the matter of the execution of Caracciolo are quite unfounded. Caracciolo was a traitor, tried and condemned by a court-martial composed of his own fellow-countrymen, and in confirming the sentence Nelson only executed his duty. In June, 1800, he returned to England, having had during the previous twelve months serious differences with Lord Keith, who had succeeded Earl St. Vincent as Commander-in-Chief. Nelson considered himself seriously aggrieved by Lord Keith's appointment, and behaved towards him, on more than one occasion, in a way which, in any officer of less distinction than himself, would have been considered highly insubordinate; and Lord Spencer, at that time First Lord, had himself to take him to task. However, in January, 1801, he again hoisted his flag as second in command to Sir Hyde Parker, then proceeding in command of the fleet ordered to the Baltic; and on 2nd April came the bombardment of Copenhagen, where he undoubtedly carried off the honours

of the day. In May, 1803, he was appointed, on the fresh outbreak of war with France, Commander-in-Chief in the Mediterranean, and after two years of most arduous service England's greatest Naval Commander completed his glorious career by the crowning victory of Trafalgar.

Nobody, we feel convinced, can read Professor Laughton's narrative without deriving great pleasure from its perusal, and it will be generally conceded that not only is this little volume in every respect a worthy companion to those of the series, for which it has been written, but that the task of writing a life of Nelson could not have been confided to better hands than those of Professor Laughton. H. G.

The Valley of Kashmir. By WALTER R. LAWRENCE, I.C.S., C.I.E., Settlement Commissioner, Kashmir and Jammu State. London: Henry Frowde, Oxford University Press Warehouse.

Apart from that superficial knowledge of a country, such as is gleaned by the ordinary globe-trotter, or the wearied Anglo-Indian luxuriating on privilege leave, Kashmir is to a great extent a *terra incognita,* and we welcome gladly an account of this interesting land from the pen of one whose life and work, both official and private, have of necessity brought him into constant and close contact with its people. Mr. Lawrence's work is a blue-book, but a blue-book of vastly entertaining matter. In it we are told all that there is to know about Kashmir. Its geology, flora, and fauna are described. Its political and social life, its religions, its races and tribes, the state of its agriculture and industries, are all dealt with, and dealt with in a manner that not only informs but interests. Kashmir, with its natural beauties and delicious climate, has long been to the fever-stricken Anglo-Indian an ideal health resort, and there is a probability that it may some day become the health resort of the world. Consumption so rife in Europe is there almost non-existent. Malarial fever, liver complaints, and dysentry, the commonest of tropical diseases, are rare. Typhoid is practically unknown. Small-pox unfortunately is very prevalent, but with the spread of vaccination, this fell disease must (as it already is in Europe) become practically eradicated. Another scourge of the country is cholera, which has its nursery in the filthy slums of Srinagar. Dr. Harvey, writing at the time of the great cholera epidemic of 1892, says: "It is not too much to say that the inhabitants eat filth, drink filth, breathe filth, sleep on it, and are steeped in it and surrounded by it on every side." This disease also is to a great extent preventible, and as, under recent administration, sanitary conditions are sensibly improving, it may be confidently hoped that cholera visitations will become less frequent and less virulent. Mr. Lawrence does not think that Europeans as ordinary agricultural colonists could thrive in Kashmir, but he does believe that they could do well by devoting "capital and labour to the production of wine, hops, canned and dried fruits, vegetables, and silk." Of the hop industry in particular he is especially sanguine. A retired naval or military officer, for example, would probably do better in Kashmir than by investing in a Florida orange grove, or a California fruit farm, and would moreover have sport and surroundings likely to be more congenial to him. *A propos* of sport, we would cordially recommend to our readers that chapter which deals with the fauna of the country, and in which the writer advocates the formation of an association for the purpose of controlling sport in Kashmir. That such is necessary, is amply proved by the case he quotes of a person (Mr. Lawrence wisely does not call him either a gentleman or a sportsman) who killed fourteen stags "which were driven through the deep snow, past the chair on which he was comfortably seated."

Towards the end of the book, Mr. Lawrence gives a very full description of the old administrative system and the new settlement inaugurated by Mr. Wingate, in 1887, and carried to a successful conclusion by Mr. Lawrence himself. No

system of revenue collection could have been more rotten and corrupt than that in force under the old *régime*. Taking at random an average village, Mr. Lawrence gives a list of the revenue *and perquisites* collected from it in 1883. The legitimate permanent revenue (or *kaul*) amounted to Rs. 1,038, and in that year extra taxes to the amount of Rs. 294 were levied, making the total to be collected Rs. 1,332. In addition to this the perquisites (*rasum*) taken from this village alone amounted to Rs. 270, that is to say, over 20 per cent. on the revenue collected. As each *tahsil* had on an average from 150 to 200 villages, it is easy to understand how the *tahsildar* and his understrappers could live, not only comfortably but luxuriously, on a rate of pay meagre in amount and frequently in arrears. But under the new settlement all this is changed, and this change we cannot describe better than in Mr. Lawrence's own words: "The State by its justice and moderation has won the confidence of the agricultural classes, and Kashmir is now more prosperous and more fully cultivated than it has been in the memory of man. The deadly cholera of 1892 and the disastrous floods of 1893 have done their worst, but the affected villages survive, damaged but not broken, and the rent-roll remains unimpaired. The agriculturists, who used to wander from one village to another in quest of the fair treatment and security which they never found, are now settled down on their lands and permanently attached to their ancestral villages. The revenue is often paid up before the date on which it falls due, and whereas in 1884 it was necessary to maintain a force of 7,429 soldiers for the collection of the revenue, now the *tahsil chaprasi* rarely visits a village. The publican has disappeared from the scene, and the villages have now to deal with *tahsildars*, whose pay enables them to live respectably. Every *assámi* (who may be broadly defined as an hereditary freeholder) knows his revenue liabilities in cash and in kind, and he quickly and successfully resists any attempt to extort more than the amount entered in his revenue book. The more serious evils of *begár* (forced labour) have been removed, and the cultivator has ample time to look after his fields. The annual dread that sufficient food-grain would not be left for himself and his family has ceased, and the agricultural classes of Kashmir are, I believe, at the present time as well off in the matter of food and clothing as any agriculturists in the world."

Mr. Lawrence's book—well written, full of information, and excellently illustrated—will well repay study, and the reader will rise from its perusal with a knowledge of Kashmir and its people such as he could have acquired from no other source. H. L. G.

Leben und Wirken des Generals der Infanterie und kommandirenden Generals des Vten Armee Korps Carl von Grolman. By General E. von CONRADY. Second Part, "The War of Liberation, 1813 to 1815" (with plans and maps). Berlin: Mittler. Price, 13s. 2d.

A notice of the first part of this work appeared in the November number of this Journal, 1894. The interest in this, the second and last volume, is most abundantly maintained. The chapters relating to the campaign of 1814 should be read with the closest attention by all students of the Napoleonic legend, for by revealing the interior dissensions with which the allied armies were riven, they compel one to an altogether different appreciation of the military lessons of that campaign than the one current in England, and which will be found in General Hamley's "Operations of War." The military events of the campaign were, in fact, so closely conditioned by political intrigue, as to render them practically worthless as illustrations of any particular strategic method. In the campaign of Waterloo there occurs at least one incident which, we believe, will be new to most students, and we, therefore, reproduce it at considerable length. The 4th Corps reached St. Lambert at ten a.m., the main body at one p.m., the 14th brigade at three p.m.

"The battle between the French and English had been raging since one p.m.

"Bulow, as we know, had the order to attack at once under these conditions. To do so he had to cross the difficult defile formed by the Losne stream, and then to deploy on the further side. This proceeding would be greatly facilitated by the occupation of the wood of Frischermont, which, fortunately, the French had left unguarded; indeed, successful deployment depended on this occupation. Nevertheless, Bulow took no steps to effect this operation, although at one o'clock he had already three brigades in hand, and by three the whole of his corps was on the ground. Meanwhile, one could see the development of the French attacks which the British withstood with unequalled heroism.

"Major von Lützow, of the general staff, had been for some hours in the wood of Frischermont, waiting in vain for some effect to be given to his repeated requests to occupy the wood, and at last, leaving a detachment to continue the observation of the enemy, he rode back to St. Lambert, where he found the Field-Marshal and Gneisenau, to whom he reported the situation, and begged for immediate action, but no decision was come to. Fortunately, at this moment, Grolman, who had been left behind in Wavre, rode up, and on hearing the state of the case from Major Lützow, at once said, '*aber marsch, marsch, in des Feldmarschalls Name befehle ich, sofort über das Defilee zu gehen,*' attack at once, in the Field-Marshal's name I order you to cross the defile immediately. The order was at once obeyed."

The above quotation reveals a most extraordinary state of things, comment on which is needless. We can, however, accept it as substantially true that the 4th Corps was in hand and practically ready to strike at one o'clock, and every one can realise for himself how great the relief, this blow would have afforded, must have proved to our sorely-tried troops during the afternoon hours from five to eight. The importance of the admission contained in these lines is all the more remarkable, since the author shows a strong bias against England throughout, and in his preface claims the victory of Waterloo entirely for the Prussians, in defiance of the evidence of his own text.

The Relief of Chitral. By Captain G. J. YOUNGHUSBAND, Queen's Own Corps of Guides; and Captain F. E. YOUNGHUSBAND, C.I.E., Indian Staff Corps (late Political Officer in Chitral), with map and illustrations. London: Macmillan and Co., 1895. Price, 8s. 6d.

As far as it goes, this work of the brothers Younghusband gives an excellent account of the late campaign beyond the Indian border. In many ways it is so good, and the opportunities enjoyed by the joint authors were so great, that one cannot help regretting that a complete military history of the campaign was not undertaken, even at the expense of a few weeks' delay to the publishers.

For instance, there are several capital portraits in the book; but the history of the defence of Chitral Fort can hardly be considered complete without a likeness of Sir George Robertson, and many a reader without and within the profession of arms would have welcomed a portrait of Surgeon-Captain Whitchurch, V.C.

Again, the small scale map makes no attempt to show the lie of a country, very difficult to describe without some further aid. A sketch on a larger scale, however rough, which showed the main obstacles Sir Robert Low's force had to overcome, would have been very acceptable; nor are there any plans of the engagements of this force, nor of the Fort of Chitral. Photographs, it seems to us, should be used as an auxiliary to, and not as a substitute for, battle plans. Lieutenant Beynon's sketches of Colonel Kelly's actions are, however, admirably clear.

Further, such a book is surely incomplete without a clear list of the composition of the relieving force, with the names of the staff—a complete *ordre de bataille* of the troops, and a statement of the transport used. A reader of fifty years hence will search in vain for the mention of the very name of the Buffs,

or the hard work they performed. The first employment of the Imperial Service train is ignored. No details are given as to the length of marches, the formation used for this mountain marching, the length of columns, or the system of attack—subjects which would interest the military if not the general reader.

We have dwelt on these defects because we feel that a very little more would have rendered this eminently readable book a very valuable one.

The volume opens with a very clear account of the events leading up to the war, and the shifting sands of Chitral politics are minutely examined and explained. It ends with a chapter on the present situation, showing clearly the wisdom of the decision to retain some hold on the country. Far beyond the borders of Chitral our feats of arms have created a sensation, which a retirement would inevitably have undone. Weak and unstable themselves, it is strength and stability which these wild tribes respect; retirements they despise, and, as the author says, "it cannot be doubted that the withdrawal would have stamped us as a wavering, undecided power, whose policy was not to be counted on, not only in the minds of the Chitralis, but of the people of Swat, of Bajour, of Afghanistan, and of Central Asia."

The Brain of an Army: A popular account of the German General Staff. By SPENSER WILKINSON. New edition, with letters from Count Moltke and Lord Roberts. Westminster: Archibald Constable and Co., 1895. Price, 2s. 6d.

No more excellent introduction to "the conditions of modern war" could be desired by the staff college candidate than is afforded by this short study of the campaign of 1866 in Bohemia, as exemplifying the methods and practice of the German General Staff. Hitherto it has been the custom of the average text-book writer to begin with a series of complicated rules and definitions and then to proceed to explain how the enemy must be beaten in conformity with these rules and regulations, or the beating will not count. If you elect to operate on exterior lines the rules say you will be defeated by your enemy fighting on interior ones, and if, as happened in 1866, the result falls out the other way, the critics shake their wise heads, deny the victor the attribute of skill, and maintain that he ought to consider himself beaten, nevertheless.

This, Mr. Wilkinson shows us, is not the German method. With them the art of war is the practical adaptation of existing means to the desired end, viz., the defeat of the enemy, and with that purpose before them they organise their forces and design their campaigns in such a manner that when collision takes place every available man, horse, and gun will be found on the spot where their services are most required. In fact, he shows us that it is not so much the names things are called, as the method in which deeds are executed that ensures victory; and the way to guarantee their proper execution is to think out in peace-time a system which will guarantee the existence of this proper spirit when before the enemy.

On one point only do I venture to join issue with him. On page 97 he says an army is what its officers make it. Now, this is, of course, the literal truth; but it is not the whole truth in the spirit in which Mr. Wilkinson's whole work is conceived. An army is "what the whole spirit of the nation wills that it shall be," and unless the determination to possess a really reliable army is very sternly expressed, the officers alone can do but little. If the spirit in the country is against us, no efforts on the part of the officers can avail anything, for the discipline absolutely essential to success will be unattainable; but support them with public opinion as the Germans, for instance, supported their army from 1871 to 1885, and they will soon give you an army second to none in the universe.

In the preface to the second edition Mr. Wilkinson goes at length into the question of war office reformation, and shows, with his customary clearness, that the whole question lies in a nutshell. Is the question to be settled with reference to the needs of the army, or is efficiency to be sacrificed to political expediency?

Existing indications point in favour of the latter solution, but here again the decisive factor will be the Will of the Nation, and if this will is definitely and clearly expressed in favour of efficiency, the officers of the army will soon supply what is desired, and will not need to call in outside assistance either.

F. N. M.

La Cavalerie dans les Guerres de la Révolution et de l'Empire. First volume. 1792-1808. By Commandant PICARD. Saumur: Milton Fils, 1895. Price, 10s.

An exceedingly interesting chapter in the history of cavalry evolution, but one which requires to be read with considerable discretion. The transcripts of the different orders, issued regarding the training of the arm, the supply of remounts, etc., may be taken as correct, for M. Picard has had access to all official records, and has been for years Professor at the Cavalry School of Saumur, but in the historical and critical portion considerable caution and judgment must be exercised. The orders issued certainly characterise the tendency of the period, but under the conditions of the armies of the Revolution and the Empire, they afford no guarantee for the actual state of things existing at the front, and there is sufficient contemporary evidence, both from German and English sources, to render it very questionable whether these orders were ever executed in the spirit indicated. Further, M. Picard is more than usually careless in his spelling of proper names of persons and places. Within twenty pages, for instance, he spells "Clairfayt," "Clerfait," and "Clairfeyt"; which is correct does not signify, but all of them cannot be.

Again, in the history of the events on the Rhine in 1792 (p. 18), we read that Custine being unable to maintain his position on the Lahn, retired into the mountains of "Koenigstein" and "Hambourg," but ten lines further down we find him back again near Mayence, having accomplished this astounding march to the frontiers of Bohemia and the mouth of the Elbe within the limited space of sixteen days, then it begins to dawn on one that "Hambourg" must be a misprint for "Homburg vor der Höhe," and the mountains of "Koenigstein" are really the "Taunus."

In his summary of the condition of the existing cavalries with which the Revolutionary armies came in conflict, he mentions the Spanish, Dutch, and Piedmonteese, but passes over the British in silence. Still, in referring to the campaign of 1793 in the Netherlands, and the *few* successes obtained by the Austrian and British Cavalries, he says, "*mais ces cavaliers ne savaient que charger, et par toujours de la manière la plus avantageuse. D'ailleurs, la cavalerie anglaise quoique brave et bien montée exécutaient généralement mal ses charges: ses chevaux étaient mal équippés, les cavaliers n'en étaient par toujours maîtres.*" Possibly, nay certainly, we did fall far short in those days of our modern high ideal; but if we were so bad, what must the enemy have been who gave us our victories of Villiers en Couche and Cateau-Cambrésis!

Waterloo: A Narrative and a Criticism. By E. L. S. HORSBURGH, B.A., Oxon. London: Methuen and Co., 1895. Price, 5s.

We fully agree with the concluding paragraph of Mr. Horsburgh's preface, wherein he recommends the study of military history to his civilian friends. If only they would take his advice and read carefully even one campaign, the gain to us in the dark days which seem now to be so rapidly approaching would be worth millions in money and thousands of human lives—lives which will be uselessly wasted when war overtakes us, because the nation as a whole does not realise what war means, and refuses to the leaders who do know, the money and supplies they so urgently need if efficiency is to be compassed. But military history, to be of any educational value at all, must be pursued systematically, and the student must be shown the precise bearing the events of the campaign or epoch he studies have on the employment and organisation of the future. This is the

point that Mr. Horsburgh, and, indeed, all civilian writers on the campaign of Waterloo, have systematically overlooked; they have treated the matter as if the only point at issue was the fact whether Napoleon had a headache on the morning after Ligny, or whether on the next day he did or did not give certain orders to which certain consequences may be traced. These points are of real interest to the student of the Napoleonic wars as a whole, for they indicate the causes at work within the army itself, such as inefficient staff training, jealousy between the chiefs, insubordination within the ranks, etc., from which the ultimate consequences were bound to ensue, whether the actual mistakes recorded did or did not occur; for if these particular errors had not been made, others of the same nature must necessarily have happened in an army in which these causes were at work. A single battle, or even a campaign, is like an instantaneous photograph—interesting to look at, but useless unless one can read back in it the causation which led to the action of the thing or group indicated. To understand Waterloo one must have studied the whole history of the French Revolution and the origin of the Revolutionary Armies, together with their transformation under the Emperor; the decadence of the Prussians after Frederic, the culminating disaster of Jena, and the resurrection of the national sentiment throughout Germany. Nor can we afford to neglect the genesis of our own army, from the days of Moore at Shorncliffe to the close of the Peninsular campaign. Given all this, and Waterloo is both interesting and instructive; but without it, then the more careful the study, the graver will be the errors it must contain.

Blackwood's Magazine. October and November numbers.

These two short papers on the fighting off the Yalu, at Port Arthur, and on the defence of Wei-Hai-Wei deserve a far longer notice than the limits of our space permit. What particularly strikes us is the extraordinary power of assuming responsibility evinced by the six Englishmen and one American, who, under the brave Chinese Admiral "Ting," conducted the defence of the latter place. Four of these men had served as private soldiers in the British Army, yet, in spite of the somewhat limited opportunities for the exercise of responsibility which their humble position could have afforded them, they grappled with difficulties which would have severely tried a brigadier-general and his staff. It is on this power to assume responsibility, which seems to form the special birthright of the Anglo-Saxon race, that we must ultimately count when the great war cloud that threatens us breaks and discharges. The conduct of these four men indicates to our mind clearly the line all future reform in our military training must take, viz., to foster and develop by every means in our power this characteristic trait.

The Maxim Automatic Gun in Action. Published by the Maxim-Nordenfeldt Company. Price, 1s.

Attention is called to this little book for the excellence of its illustrations, showing every method in use for mounting and carrying the gun. The extracts from the papers relative to the performances of the gun in action are eye-witness testimony certainly, but, in appreciating their value for tactical study, it will be as well to remember that we have not yet seen the Maxim opposed either by efficient field artillery or even by a weapon of its own nature.

Books received during the month, awaiting review:—

The Duties of the General Staff. By BRONSART VON SCHELLENDORF. Third edition, revised and corrected by Colonel Meckel, translated by Lieut.-Colonel W. A. H. Hare, R.E. London: Harrison and Sons. Price 6s.

Cavalry in the Waterloo Campaign. By General Sir EVELYN WOOD, V.C., G.C.B. London: Sampson, Low Marston and Co. Price, 3s. 6d.

J. J. K. & Co., London.

GENERAL CHARLES 3rd MARQUESS OF LONDONDERRY, K.G., etc.

Reproduced from a Mezzotint in the possession of Captain H. Garbett, R.N., taken from an original portrait by Sir Thos. Lawrence